



FRIDAY, DECEMBER 15, 1876.

THE UNITED STATES INTERNATIONAL EXHIBITION.

XX.

MISCELLANEOUS.

STILWELL & BIERCE MANUFACTURING COMPANY, Dayton, Ohio. This company is engaged in the manufacture of "Stilwell's patent lime extracting heater and filter," which is described very

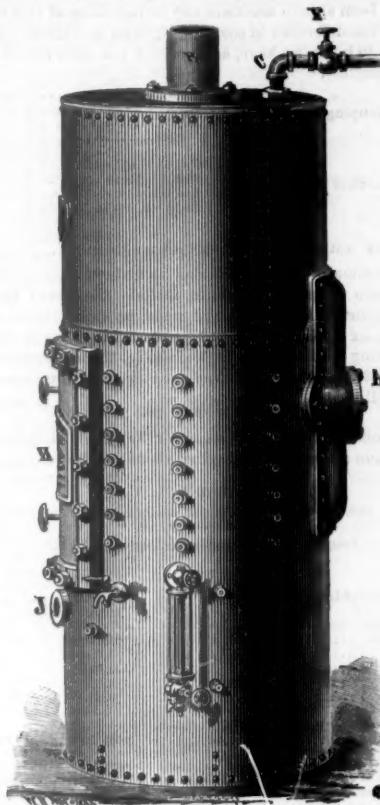


Fig. 1.

fully and clearly in a pamphlet distributed by the attendant at its exhibit. The text, as it might be called, of its argument in favor of the use of the apparatus, consisted of two extracts, one from a report made to the Master Mechanics' Association at its meeting in 1872, as follows: "The introduction into a boiler of any so-called remedies, be they batteries, powders, fluids, or any other nostrums, can hold no comparison whatever to this one perfect and reliable remedy of supplying the boiler with pure feed-water." The other portion of the text was from a report by Professor Chandler of Columbia College, New York, to the New York Central Railroad Company, in which he says: "Boiling water expels the free carbonic acid and causes the separation of the carbonates of lime and magnesia, and if conducted at a high temperature under considerable pressure, results in the almost complete precipitation of the sulphates of lime. This would, however, merely transfer the incrustation from the locomotive boiler to some other vessel." The manufacturers of the heater we are describing say that "this is just what they desire to do." The exception ought, however, to be made, that thus far they have applied their apparatus successfully to stationary engines only, although they have been experimenting with locomotives with a view of applying it to them.

The heater is shown in fig. 1 and its construction and operation will be made plain from the sectional view of fig. 1. They are thus described by the manufacturers:

"Connection is made at *A* with the escape pipe from the engine, where the steam is divided and enters the heater at two ports, one just above the upper shelf, the other opposite the lower shelf. The outlet pipe *B* for the escape from the heater of the uncondensed steam is of the same size as the inlet pipe *A*. The escape steam from the heater may be carried to any desired point and applied to any further use, such as heating rooms, steaming lumber, etc. (These steam passages are of such ample size that it is impossible that the heater should create any back-pressure upon the engine, but on the contrary, the partial condensation of the escape steam tends to relieve an engine of back-pressure). The cold water is brought from a tank by pipe *C* into the top of the heater, the supply of cold water being regulated by a suitable stop-cock. Upon the end of this cold-water pipe on the inside of the heater, and located just above and in front of the upper steam port, there is fastened a wedge-shaped cup, called the overflow box. The water fills this cup and flows over its edges in a widely distended thin sheet, falling down through the incoming current of steam on to the upper shelf. The steam, passing thus through a thin sheet of water, dashes it into fine spray, acting upon each separate particle, and imparts to the water sufficient heat to raise it to the boiling point, which sets free and precipitates the lime or other salts held in solution. The water now traverses a large area of heating and depositing surfaces, arranged in the form of removable shelves, having alternate openings. As the thin sheet of water passes over these shelves, all of which are very hot, and descends from shelf to shelf, it is met in its downward course and constantly acted upon by the ascending current of steam which enters the heater at the lower port. The action of this lower current of steam completes the separation and precipitation of the foreign particles which is begun when the water enters the heater. It will be observed that the construction of the heater is such that not a drop of water can pass down through it without being thoroughly heated.

The lime, magnesia, sulphur, iron, silica, etc., which this process of boiling sets free from the water, are deposited in a crystallized state upon the entire series of shelves, the deposit always being heaviest upon the upper shelf and diminishing in quantity as it approaches the lower shelf. From the lower shelf the water, which has now parted with all that portion of its impurities which will crystallize, passes down behind the filtering chamber into the mud well in the bottom of the heater, where the mud, sand and uncrystallized particles of lime, etc., are deposited and from whence they may be drawn off, through an opening for that purpose in the bottom of the heater, as often as may be necessary. The purification of the water is now completed by its passage from the mud well upward through the false bottom and the filtering chamber *C* to its final exit from the heater at *D*. This filtering chamber is tightly packed with hay, straw, or other suitable filtering material, which effectively retains all the light floating particles not previously arrested. By the process thus described, water that is heavily impregnated with lime, magnesia, sulphur, iron, silica, clay, mud, sand, etc., is robbed of all these scale-producing substances, and supplied to the boiler *boiling hot and pure*."

The heater is cleaned by removing the door *H*, by which access may be obtained to every part of it. The shelves are made of cast iron, with corrugated surfaces, so as to give the largest possible superficial area, and are all removable through the door.

Fig. 3 represents a front view of one of these heaters with the door removed, and shows the deposit on the shelves after being in use two weeks. The engraving was made from a photograph of a heater which had been in use that length of time at the works of Oliver Crook & Co., in Dayton, Ohio.

THE AMERICAN BRIDGE COMPANY, OF CHICAGO.—The most prominent object displayed by this company was a beautiful model of the "Point Bridge," which is now being erected across the Monongahela River at Pittsburgh. This bridge is to be constructed on a stiffened chain suspension plan. It was designed by Mr. Edward Hemberle, Engineer of that company, and will cost \$450,000. The model is made to a scale of 3-16 in. = 1 foot. The bridge and other portions of this exhibit were described as follows in a printed circular distributed at the exhibition:

"The centre span [of the bridge] is 800 feet from centre to centre of the towers, and the side spans are 145 feet each in the clear. The height of the towers above low water is 180 feet, and the deflection of the chain is 88 feet. The roadway is 20 feet wide with double tramways and one track for a narrow-gauge railway; outside of the roadway are sidewalks six feet wide each. The piers and anchorages are founded upon timber platforms sunk to a gravel bed. The masonry is of best quality Baden sandstone.

"The superstructure will be the first example of a stiffened chain suspension bridge of long span, and will differ considerably from others in existence. The chain is designed as a catenary, and will take up all the permanent load of the structure without bringing strains on the stiffening trusses. This object will be accomplished by erecting the bridge completely before connecting the ends of the straight top chords to the centre joint. The tie-rods are provided with turn-buckles and will be so adjusted as to be strained under moving loads only. When the bridge is half loaded the top chords of the trusses on the loaded side will be in compression, and of the unloaded side in tension. The maximum strains for the different members of the trusses occur under different positions of the moving load.

"There are lateral and vibration braces between the top chords, and also between the chains, proportioned to take up the strains from wind pressure upon chains and trusses. The floor is 34 feet wide between the roadway girders, which are 8 feet high, forming the handrails. The roadway girders have expansion joints every 100 feet and are suspended from the

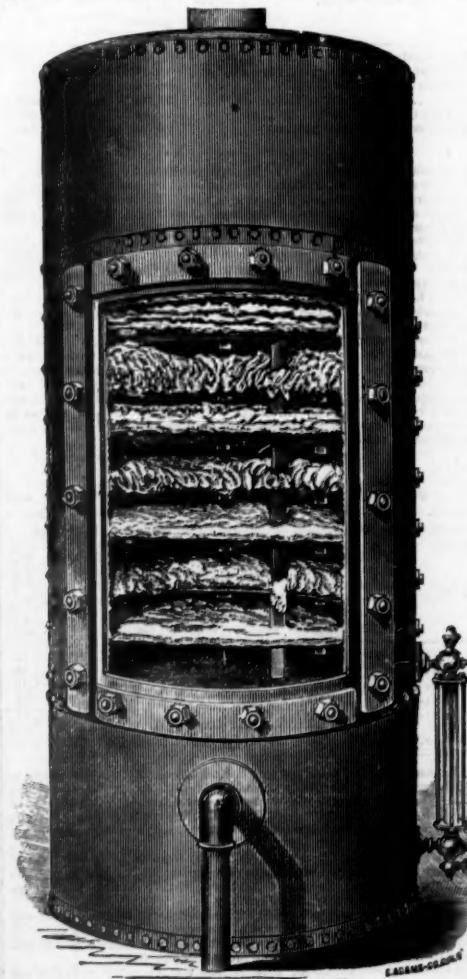


Fig. 3.

chains by flat bars 20 feet apart. At the expansion joints there are struts instead of suspenders in order to make a rigid connection between the roadway trusses and the chains. Cross-girders, 3 feet in depth, connect the stiffening girders every 20 feet, and support two lines of iron stringers. The stringers and the roadway trusses form the bearers across which are placed the wooden joists for the flooring. The lateral stiffness of the floor is secured by a double system of tie-rods, and the wind pressure will be taken up by horizontal steel wire cables, placed under and connected to the floor. The towers are entirely of wrought-iron, except the bases of the columns. The chains are carried over the top of the tower on wrought-iron chairs or saddles which are movable on rollers to allow for expansion and the elongation of the back chains under strain.

"The bridge is proportioned for a moving load of 1,600 pounds per lineal foot, under which, together with the weight of structure, the chains will be strained to 12,000 lbs. per square inch, sectional area. The suspenders and roadway members are strained only from 8,000 lbs. to 10,000 lbs. per square inch. The maximum compressive strains in the towers are 9,000 lbs. per square inch.

"The bridge will be finished by the end of this year."

This company also exhibited a model which represented an iron pier as built for Missouri River bridges at Leavenworth,

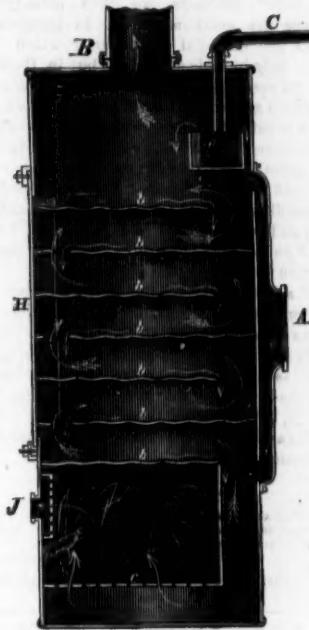


Fig. 2.

Kan., and Boonville, Mo., and stone pier sunk upon a wooden caisson by the pneumatic process, as built at various localities; details of bridge construction consisting of an eye-bar 8 ft. \times 2 ft. for the stiffened chain suspension bridge; W. G. Coolidge and Edward Hemberle's patent post, which is used by the American Bridge Company for bridges and trestles; top and bottom chord connection for an 84 feet span railroad bridge, which show the mode of construction generally used by this company. The more important structures built by it were illustrated by photographs and photo-lithographic designs. The Hudson River Bridge at Poughkeepsie was represented by a painting 6 \times 14 feet in size.

The exhibit represented very clearly and satisfactorily the work done by this company, and was in every way creditable to the exhibition.

Contributions.

The Justifiable Expenditure for Improvement in the Alignment of Railways.

BY ARTHUR M. WELLINGTON, C. E.

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(Continued from Page 521.)

ASSISTANT ENGINES.

We know of no better introduction to this subject than the following remarks of Mr. Herman Haupt, in a paper on the adjustment of the gradients of the Shenandoah Valley Extension Railroad, published in *Van Nostrand's Engineering Magazine* for 1873, and also in the *Railroad Gazette* for July 5, 1873, page 267:

"The load of an engine on any working division is determined by the maximum resistance offered by grade and curvature, and except where assistant engines are employed no greater load can be carried over the division than can be carried over the point of greatest resistance. While, therefore, it may be expedient to make large expenditures to reduce the maximum resistances on any division, yet when these have been established it is not proper to sacrifice capital by reducing points of less resistance, as not a single car could thereby be added to through trains, or any appreciable economy of operations secured."

"This being understood, an attempt will be made to prove, contrary to the generally received opinion, that undulating gradients below the limits of maximum resistance are not objectionable, and that while admitting of great economy of construction they do not materially increase the cost of operation, as compared with uniform and low gradients between the same points; also that the use of higher gradients for part of a given distance will often result in greater economy of operation than a lower and uniform gradient for the whole distance."

"It was formerly the practice of engineers to compare different lines of railway by conceding a given amount of rise and fall as equivalent to a mile of distance. This is not correct practice. The profile of the line and the direction and amount of tonnage, or, in other words, the maximum resistances and their distribution over the line, are the elements to determine questions of relative economy of operation. The rise and fall affect the question very slightly.

"If the maximum resistances can be concentrated at one point and overcome at once with the aid of assistant engines, while lighter gradients in favor of the direction of the tonnage prevail

on all the rest of the route, the line will be operated cheaply. But if the maximum resistances are scattered over the whole line, at intervals more or less remote, the operation will be expensive.

"In the solution of the problems in railway economics it is not safe to apply general rules or principles too freely. Each line presents a problem in itself, the solution of which should depend on the particular data which the case presents; millions of dollars have been sacrificed by conforming to general rules and theories when circumstances required variations.

"A practical illustration, having reference to the system of gradients recommended, will make this subject sufficiently clear to the practical reader. Suppose the gradient which determines the load of an engine over any division is of 30 feet to the mile, and that it would be practicable by an expenditure not excessive to locate a portion of the division with a uniform ascending gradient of 6 feet to the mile, but that by ascending at the rate of 36 feet to the mile for five miles and descending 24 feet to the mile for the remaining distance a large saving could be effected in construction. There are few perhaps who would not make a sacrifice to secure the lower gradient, and yet it can be shown that it has no advantages even in economy of operation over the undulating and much higher gradient."

These remarks are all sound in the highest degree, and in so far as they apply to the relative cost and disadvantages of ruling and minor gradients, we have already endeavored to enforce the same argument in previous papers, by pointing out the essential dissimilarity which exists between them, not only in their magnitude but in their character. We now proceed to consider the economical and engineering laws which govern the use of ASSISTANT ENGINES, promising that the great advantages which may be secured by their use under proper conditions, and the absolute necessity of careful attention to those conditions if we are to reap such advantages, is but little appreciated by many locating engineers. The possibility of using assistant engines should always be kept in view on low-grade lines and high alike, for the advantages on the former may be far greater than on the latter.

THE POWER OF ASSISTANT ENGINES.

By the use of assistant engines the limiting effect of even very high gradients is in effect reduced below that of very much lower ones on other points of the line, and it is evident that economy in motive power requires that these gradients should as nearly as possible balance each other in order that the true ruling grade may be the lower grade worked by one engine. Table K, below, shows these equivalent grades for either one or two assistant engines, whether of equal weight or heavier by a certain percentage.

TABLE K.

SHOWING THE PROPER ADJUSTMENT OF RULING GRADES FOR THE USE OF ASSISTANT ENGINES, ACCORDING TO THE AVERAGE DAILY PERFORMANCE OF ENGINES ON ALL AMERICAN RAILWAYS.

RULING GRADE WORKED BY ONE ENGINE, in foot per mile.	Grade up which the same train can be drawn by the aid of—					
	ONE ASSISTANT ENGINE		TWO ASSISTANT ENGINES			
	of equal weight on drivers.	heavier by 20 p. ct.	of equal weight on drivers.	each heavier by 20 p. ct.	of equal weight on drivers.	40 p. ct.
Level.	24	29	33	46	54	62
10	42	48	53	70	80	90
20	59	66	72	92	104	116
30	76	84	91	113	126	138
40	92	101	109	133	147	160
50	107	117	126	152	167	180
60	122	133	142	160	185	199
70	136	148	158	186	201	216
80	150	162	173	201	217	232
90	164	176	187	216	232	247
100	177	189	201	230	247	261
110	190	202	214			
120	203	215	227			
130	215	227	239			
140	227	239	251			
150	239	250	262			

REMARKS.—This table is practically independent of all variations in the pattern of engine, ratio of adhesion and rolling friction. A lower rolling friction slightly decreases the grades for assistant engines, as follows:

For a Rolling Friction 2 lbs. per ton less, (8 lbs.)

Subtract from grades given	For 1 Asst. Engine.	For 2 Asst. Engines, opposite.
Level.	4	8
50	3	5
100	2	3

An increase in the ratio of adhesion above the average assumed (1.5) would also have the effect to slightly decrease the grades for assistant engines, or about 1-12 of the maximum grade for one engine when one assistant engine is used, and by about 1-8 when two assistant engines are used, provided the net load for one engine were increased in proportion; but as a matter of fact, trains are almost invariably made up on all railways to oppose a maximum resistance equal to 1-5 of the weight on drivers, and the variations either way are very slight.

A variation in the pattern of engine has only the effect of increasing the weight of the train by the amount by which the weight on the truck and tender is decreased. The above table is calculated allowing half the gross weight of engine and tender as available for adhesion ("Mogul" engine).

Table K requires no explanation or justification of the premises assumed (in respect to rolling friction, adhesion, etc.), because it is practically independent of all premises, with the inconsiderable variations set forth below it. It is deduced by inspection from the table on page 442, Table XVII., of which we have already made such frequent use, in the following obvious manner: On a grade of 30 feet per mile, for example, any engine will haul in daily practice 83.6 tons per ton of adhesion (i. e., per five tons on drivers), as nearly as may be. If a "pusher" of equal weight be attached to that train, the net load per ton of adhesion is at once reduced to 41.8 tons. The grade up which an engine will draw 41.8 tons per ton of adhesion is, by Table XVII., 76 feet, which is the equivalent gradient required. If the pusher be 40 per cent. heavier, we have, to haul each 83.6 tons of net load, 2.4 tons of tractive power. Then $\frac{83.6}{2.4} = 34.83$ tons, and the equivalent gradient thereto is 84 feet. The process is so simple as to require no further explanation.

It is to be remembered in testing or applying the table that if the lower grade be complicated by unreduced curvature, according to a wasteful but common practice, it is in effect in-

creased a very considerable amount. We shall consider this subject with some care in our next paper, and therefore will only add that a 6° curve is equivalent in its *limiting effect* on trains—although not in pounds of resistance to the short trains which it renders necessary—to a grade of 15 to 30 feet per mile.

THE DUTY OF ASSISTANT ENGINES.

This seems to be about 100 miles a day, if they have a chance to run it, and at least equal to, if not considerably in excess of, the mileage of ordinary through engines. The Philadelphia & Reading Railroad has a grade two miles long which is worked with two assistant engines weighing 36 long tons each, or from 10 to 20 per cent. more than the regular coal engines. These engines, in 1873 and 1874, pushed about 25 coal trains daily up the incline, making an average mileage of 31,500 miles a year, an excess of more than 50 per cent. over the average duty of all the engines on the road, which for three years was only 20,500 miles. In 1875, however, and also in 1867 and 1868 (the only years for which the writer has reports), the business was lighter and the two assistant engines were only able to make about 22,500 miles, thus increasing the expense somewhat, as will be seen below (Table XXIII.). But in those years the mileage of the other engines suffered from the same cause, for we find it amounting to only 17,600 miles, so that the mileage of assistant engines exceeded the average in those years also by a large percentage (28 per cent.) Mr. Benj. H. Latrobe, in a report on the location of the Pittsburgh & Connellsville Railroad (1868), gives the following opinion in reference to the duty of assistant engines: "On the seven miles west of the summit, engines will be assisted by auxiliary power, one of such helping engine being sufficient to take six or seven trains to the summit daily, as the long experience upon the Baltimore & Ohio Railroad at Parr's Ridge, 45 miles from Baltimore, has proved." Mr. Herman Haupt also, in an address before a committee of the Massachusetts Legislature before referred to, gives as the result of his long experience on the Pennsylvania Railroad that an assistant engine can be relied on to average five trips daily over a 10-mile incline, thus amounting to 100 miles daily duty, or about the same as Mr. Latrobe's estimate (84 to 98 miles) above. The writer has been unable to obtain any further data, but the estimates of both the distinguished engineers above are considerably over the duty which is realized in practice with ordinary locomotives, if we may trust the indications of the following table, (Table XXII.). It is very common to estimate the average duty of engines at 100 miles a day, or 30,000 miles a year. This is correct enough while the engine is running, but the average duty, including time lost for repairs, would seem in practice to be more frequently under than over 24,000 miles a year, or for 300 days in the year (leaving out 25 days as lost for repairs, which would perhaps more properly be 35 or 40 days) 80 miles a day. There would therefore seem sufficient reason to believe that assistant engines will realize a somewhat higher

er mileage than the average locomotive, when there are sufficient trains to keep them busy.

THE COST OF ASSISTANT ENGINES.

This is usually estimated by all engineers at about the same cost as for the engines in ordinary use. The following table (Table XXIII.), however, would seem to indicate that the cost per mile run is somewhat higher for assistant engines, and the writer believes these statistics to be entirely trustworthy. It is to be remembered, however, that Table XXIII. does not show an important advantage of assistant engines, viz., that although the cost per mile run may be somewhat higher, assistant engines will realize a higher *yearly* duty than ordinary engines, owing to the nature of their service; and the saving in capital invested from this cause, if it exists, would nearly or quite make up the difference in cost per mile run. The writer has not been able to ascertain any further facts of this character, but the difference in cost, if any, must be trifling. Assuming this to be so, we have, as the cost per mile run of an assistant engine :

Direct Running Expenses.....	Fuel.....	10 cts.
	Oil and water.....	2 "
	Repairs.....	9 "
	Wages.....	6 "
		27 cts.
Maintenance of Way Expenses.....	Renewal of iron.....	7 cts.
	Track repairs.....	3 "
	Yards and structures..	6 "
	Roadbed rep'res (58 p.c.)	4 "
		20 "

Total cost of an assistant engine per mile run..... 47 "

The estimate of the cost due to maintenance of way has been made purposely large, to include the cost of the additional switches and buildings made necessary by assistant engines, for which it is impossible to make a general estimate.

Assuming then 47 cents per train-mile, the additional cost per year per daily train if operating one mile of track with assistant power will be

$$0.47 \times 2 \times 325 = \$305.50.$$

This amount forms the basis for Table L—1 below, and is based upon an average mileage of about 80 miles a day, but if

TABLE L—1.
SHOWING THE CAPITALIZED COST OF ASSISTANT ENGINE SERVICE PER MILE INCLINE.
(Average cost of a train-mile assumed at \$1.00.)

Rate of Interest on Capital.	Per daily train.	Per \$1,000 of annual expenses per mile.
5 per cent.....	\$7,110	\$9,400
6 "	5,992	7,833
7 "	4,864	6,714
8 "	3,810	5,875
10 "	2,065	4,700

YEARLY COST per mile of assistant engine service..... \$305.50

\$470.00

REMARKS.—The sum given as the cost of assistant engine service per \$1,000 of annual expenditure is simply equivalent to saying that the cost of assistant engine service is 47-100 of the average cost of a train-mile as before determined. The sum given per daily train is 650-1,000 of this amount.

It is impossible to realize this mileage, owing to the special operating conditions, the cost of assistant engine service is but slightly increased. Thus, supposing assistant engines are only able to average 60 miles a day instead of 80 miles, we may estimate the cost per mile which might be run, if standing in the yard with steam up, at about 25 per cent. of the cost while running, as follows:

NAME OF ROAD.	Numb'r of years aver-aged.	Average yearly mileage of en-gines.	Average per-cent-age engines in ser-vices in 1875.	Cost per mile while running.	In yard with steam up.
Pennsylvania.....	7	20,600	0.17	1,069	5 cts.
Philadelphia & Reading.....	4	19,200	0.08	410	
Louisville & Nashville.....	4	20,200	...	118	
Erie.....	4	25,700	0.10	661	
New York Central.....	4	28,900	...	558	
Lake Shore & Michigan Southern.....	2	24,700	...	495	

REMARKS.—Pennsylvania: The high proportion of engines in shop is doubtless owing in large degree to extensive reconstructions of engines which have been recently in progress. The yearly mileage has increased about 30 per cent. since 1869. Distributing service (work trains) constitutes 4 per cent. of the total mileage.

Louisville & Nashville: The average mileage is for main line only, and also the number of engines. Total number, including branches, 1875. The average mileage per engine for the whole road was in 1874-5 only 14,000 miles.

Erie: The mileage reported has been increased 4 per cent. to include work-train mileage not given in State reports. Engines reported as broken up were excluded.

New York Central: The very heavy mileage is owing in great degree to the enormous proportion of work trains (nearly equal to passenger service) while constructing quadruple track, although doubtless the recently adopted system of long runs co-operated. In 1867 the average mileage was only 19,500 miles. No deduction was made from the reported number of engines for engines broken up, as in the case of the Erie, as was thought to be just. Neither was any similar deduction made from the Lake Shore reports.

It appears from this that the cost of standing idle while 20 miles might be run is only equivalent in cost to about five miles of additional run, thus increasing the cost of assistant engine service by 5-60 or about 8 per cent. If the assistant engine makes 70 miles, the loss is only equivalent to 2.5-70, or 3.5 per cent. Under ordinary circumstances it would be very poor management which did not realize more than 60 miles a day from assistant engines, and as they are quite as likely to exceed the average mileage as to fall below it, this source of error may be neglected.

These data determined, we may now proceed to consider the question of

ASSISTANT ENGINES VERSUS UNIFORM GRADES.

If we have two alternate locations, A B, and A' B', Fig. 1,



one of which it is designed to work with assistant power and one without, by adopting the line with assistant power.

1st. WE GAIN—what is equivalent to a reduction in the ruling grade—the amount of which will depend on the skill and good fortune with which the grades have been adjusted, but which should closely approximate to the difference between the gradients given in Table K above.

2d. WE LOSE the cost of assistant power on the incline A-B'; \$30,550 yearly, per daily train, per mile of incline.

The problem being thus stated, the values which we have previously determined give us a ready and simple method of

solving it. Thus if, in Fig. 1, we have estimated the probable number of daily trains required on the line having 33 feet maximum grade—for the 80 feet incline is reduced in limiting effect to 33 feet by the use of assistant engines—then by adopting the line having a uniform maximum grade of 50 feet we have in effect increased the maximum grade 17 feet per mile. Now, assuming the latter line to be 105 miles in length and the former 100 miles, with an incline of 10 miles to be operated with assistant power, the comparative operating value of the two alignments would be as follows, allowing the rate of interest on capital to be 7 per cent:

In favor of the line for assistant engines, 17 ft. per mile saved in ruling grade, over 33 ft., value, by Table E, \$8,513 \times 17	105	\times 100 = \$151,967
In favor of the line of uniform gradient, 10 miles saved of assistant engine service, value, by Table L-1, \$4,364 \times 10 =	43,640	
Net difference in operating value—due to gradients only—in favor of the low-grade line; per daily train.		\$108,317
Value of 5 miles of distance in favor of line for assistant engines, by Table A, \$3,900 \times 5 =		19,500
Total difference in operating value, per daily train, in favor of low-grade line.		\$127,817

This process would seem to be simple enough, requiring only the intelligent application of formulae already determined. But we may still simplify it by determining what we may call an *equating ratio*, given in Table L-2 below, which gives the distance per mile of road over which we may afford to use assistant power to avoid increasing the ruling grade *one foot per mile*. This ratio, multiplied by the entire length of the line and by the number of feet reduction in ruling grade which is in effect obtained by using assistant engines, gives the difference over which we can afford to use assistant power, and the difference between this distance and that actually required gives—when multiplied by the capitalized value per mile of the saving in assistant engine service—the difference in the operating value of the two alignments so far as affected by the gradient alone.

TABLE L-2.

SHOWING THE DISTANCE PER MILE OF ROAD OVER WHICH ASSISTANT ENGINES MAY BE ECONOMICALLY EMPLOYED TO AVOID AN INCREASE OF ONE FOOT IN THE EQUIVALENT MAXIMUM GRADE.

MAX. GRADE other than that operated by assistant engines.	Cost per mile of line of increasing grade 1 ft.	Cost per mile of assistance in engine service.	Equivalent dist.
			for use of assistant engines; in miles per mile of line.
Level.	\$12.48	\$305.50	0.0408
5.	10.61	"	0.0347
10.	9.67	"	0.0316
15.	8.42	"	0.0267
20.	7.49	"	0.0237
25.	6.86	"	0.0225
30.	6.24	"	0.0204
40.	5.30	"	0.0173
60.	4.68	"	0.0153
60.	4.37	"	0.0143
80.	3.74	"	0.0122
100.	3.43	"	0.0112

Thus, applying Table L-2 below to our example above, we find that the distance over which we may use assistant engines to avoid an addition of one foot to the ruling grade is 0.0195 miles per mile of line. Then, for a saving of 17 feet (50 ft.—33 ft., Fig. 1) we have

$$0.0195 \times 17 \times \frac{105}{100} = 34.8 \text{ miles.}$$

Subtracting the actual distance required, 10 miles, we find that the economy of the low grade is represented by 24.8 miles of assistant engine service, and, by Table L-1

$$24.8 \text{ miles} \times \$4,364 = \$108,227,$$

or the same as we obtained above in another way, less a decimal error. The difference in the distance of course is a separate matter, to be subsequently determined. For the purpose of comparing the gradients we must assume the lines to be of the same length as pointed out in the last paper.

Now as a check upon the correctness of all this process, if the reader will take the trouble to turn to Table XX. on page 457, and compute from it the engine mileage requisite to move any given number of cars over each of these two lines, he will find it to be exactly represented by a saving of 25.3 round-trip miles per train over the low-grade line. The slight difference between this distance and the 24.8 miles determined above is an expression of the fact that the balance between the *expense accounts* of the two lines would not be exactly in proportion to the difference in the mileage accounts. As it happens, the nature of this particular problem is such that the difference is quite small. We have thus, after a very roundabout course, checked back on our bench-mark, affording reasonable assurance of correctness throughout, and if at any point in this long discussion we have seemed to be getting far away from a basis of financial fact in the deduction of theoretical formulae, the reader may feel assured that he can come down to hard-pan at any point by a similar process. The writer expresses himself with great confidence on this point, because he has "been there" an innumerable number of times in endeavoring to keep himself right.

We have now finished our theoretical consideration of the subject of gradients, and so far as our ability and foresight has enabled us to do so, have provided a correct and convenient basis for a settlement of all the various problems which arise—or should arise—in their adjustment. But, like the wisdom of the famous Bumsby, "the bearing of these observations lies in the application of them," to a far greater extent than in considering the value of these details of alignment, such as curvature and distance, and here we pass beyond the point where a theoretical discussion can be of much value. We may furnish the means for deciding the comparative values of alternate alignments with the utmost neatness and correctness—or an able writer may do so for us—but we cannot formulate rules by which to find those lines, nor to perceive the operating or constructing advantages of a wholly different lo-

cation, which, nevertheless, may lie upon the surface. This is more or less true, of course, with respect to all the minor details of alignment; but still, so far as curvature and distance and rise and fall are concerned, a man may stumble along from mile to mile and from section to section, doing the best he can in each, and in the end come out not far from right—if he has been guided by proper estimates and not solely by guesswork. But when this method is followed in the all-important question of the adjustment of gradients—as it too frequently is—it is simply ruinous. For the gradients must be adjusted as a *complete whole*, after the most careful consideration of all the broad topographical features of the region to be traversed, and of the conditions of operating economy for the particular traffic in view. The line of lowest grade may not be the cheapest to operate: very frequently it is far from the cheapest. A wholly different location with a wholly different system of gradients may give great operating advantages and at the same time largely reduce the cost of construction. This possibility, however, cannot be discussed in any general form, and we know of no way to so effectually impress it upon the mind of the reader, and at the same time give an excellent practical example of the great economy which may result from the use of assistant engines with gradients skillfully adjusted thereto, as to make a comparison in some detail between the actual and possible lines of two prominent railways, the facts for which happen to be within the writer's knowledge. This, however, we must postpone till the following paper.

[TO BE CONTINUED.]

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Washington City, Virginia Midland & Great Southern.—The following circular from General Manager Foreacre bears date Dec. 1: "It is announced with regret that W. D. Chipley, General Southern Agent of this company, resigns his position, to take effect 15th inst., to accept the appointment of General Manager of the Pensacola & Louisville Railroad. All communications relating to the business of this company, heretofore under his control should be addressed to J. M. Broadus, General Ticket Agent, Alexandria, Va."

Pensacola & Louisville.—Mr. W. D. Chipley has been appointed General Manager. Mr. Chipley has been for three years past General Southern Agent for the Baltimore & Ohio and Virginia Midland roads, in which position he has made an excellent reputation as an active and energetic officer.

Nashville, Chattanooga & St. Louis.—Mr. George R. Knox has been appointed General Freight Agent, in place of Major C. W. Anderson, resigned. Mr. Knox has been connected with the freight department for 14 years.

Illinois Central.—Mr. B. F. Ayer has been appointed General Solicitor, in place of George Trumbull, resigned.

Kansas Pacific.—Mr. D. E. Cornell is appointed Acting General Passenger Agent, in place of E. A. Parker, deceased.

Hannibal & St. Joseph.—Mr. Wm. Wilms has been appointed Auditor.

Havana, Randolph & Eastern.—Mr. Lewis Steward, of Plano, Ill., has been chosen President, in place of B. J. Gifford, resigned.

Ohio & Mississippi.—Mr. Charles S. Cone is continued as Treasurer to the Receivers. Mr. Charles S. Cone, Jr., is appointed General Passenger Agent, in place of R. T. Brydon, resigned.

Pittsburgh, Cincinnati & St. Louis.—The office of Mr. D. T. McCabe, Division Freight Agent Second and Third Columbus, Chicago & Indiana Central divisions, has been removed from Logansport, Ind., to No. 88 La Salle street, Chicago.

Shenango & Allegheny.—The officers are now as follows: President, S. C. T. Dodd, Franklin, Pa.; First Vice-President, Thomas H. Wills, Youngstown, O.; Second Vice-President, R. B. Roosevelt, New York; Treasurer, C. A. Derickson, Meadville, Pa.; Secretary, John H. Dynes, Meadville, Pa.; Auditor and Superintendent, J. T. Blair, Greenville, Pa.

Dakota Southern.—At the annual meeting in Sioux City, Ia., Dec. 6, the following directors were chosen: W. W. Brookings, W. A. Burleigh, A. H. Morrison, J. H. Potter, J. M. Stone, C. G. Wicker, J. H. Wicker. The board elected C. G. Wicker, President; A. H. Morrison, Vice-President; J. H. Wicker, Treasurer; J. R. Hanson, Secretary; G. E. Merchant, General Superintendent.

Pittsburgh & Connellsville.—At the annual meeting in Pittsburgh, Pa., Dec. 4, the old board of directors was re-elected, as follows: W. S. Bissell, G. L. B. Fetterman, Wm. Baldwin, Charles Donnelly, John D. Scully, Pittsburgh; W. H. Koontz, Somerset, Pa.; W. H. Markle, Greensburg, Pa.; John King, Jr., Menden, Cohen, Hugh Sisson, Charles Webb, John Donnell, Smith, Baltimore. The road is worked by the Baltimore & Ohio. The board met subsequently and elected John King, Jr., President; J. B. Washington, Secretary; Charles Donnelly, Treasurer.

New Haven & Northampton.—Lieut.-Gov. Knight, of Easthampton, Mass., has been chosen a director, in place of Morris Tyler, deceased.

Burlington & Missouri River in Nebraska.—Mr. Percival Lowell, General Ticket Agent, has been appointed Acting General Freight Agent also, in place of Charles Piers, resigned. Mr. J. M. O'Grady has been appointed car accountant.

Carolina Central.—Messrs. A. T. Stout, J. H. Porter and J. B. Grainger have been appointed Receivers. They have continued Mr. V. Q. Johnson as Superintendent and Engineers, with the subordinate officers.

Chicago, Peoria & Southwest.—Mr. D. H. Conklin has been appointed Acting Superintendent, in place of W. P. Sisson.

Cincinnati & Eastern.—The officers are now as follows: President, S. Woodward; Secretary and Auditor, William Mansfield; Treasurer, M. Jameson; Superintendent, George H. Wilber. The offices are at Batavia, Ohio.

Cincinnati, Sandusky & Cleveland.—Mr. S. P. Hare has been appointed Superintendent of Telegraph and Train Dispatcher, in place of W. H. Brimson.

Genesee, Ithaca & Sayre.—Ticket reports should be sent to A. W. Nonnenmacher, Passenger Accountant, Manch Chunk, Pa.; other communications on passenger business to W. H. Sayre, General Agent, Manch Chunk, Pa.

Michigan Air Line.—The officers now are: President, J. B. Eaton; General Manager, Wm. Young; General Superintendent, M. A. McNaughton; General Freight and Ticket Agent, J. E. Young; Offices at Jackson, Mich.

New Orleans, St. Louis & Chicago.—Mr. Royal Keith has been appointed General Eastern Passenger Agent, with office at No. 291 Broadway, New York.

New Orleans & Mobile.—Mr. F. P. Marsh is appointed Eastern Passenger Agent, with office in New York.

St. Louis, Alton & Terre Haute.—Mr. B. Warren, heretofore

in charge of the Machinery Department, has been appointed Superintendent of this company's Bellville Line.

Cincinnati Southern.—Mr. G. Boucaren, for several years Principal Assistant Engineer, has been appointed Consulting Engineer, in place of Mr. Thomas D. Lovett, resigned.

Richmond & Danville.—Mr. R. D. Wade, Master Mechanic of the North Carolina Division, has been placed in charge of the machinery of the entire line, and has moved his headquarters from Company Shops, N. C., to Richmond, Va.

Missouri Railroad Commission.—At the recent election Messrs. James Harding, John S. Marmaduke and John Walker were chosen Railroad Commissioners of Missouri. The two last-named are members of the present board.

Ithaca, Auburn & Western.—The first board of directors of this company, organized by the bondholders who bought the Western Extension of the New York & Oswego Midland, is as follows: Charles P. Wood, J. Lewis Grant, Auburn, N. Y.; H. R. Low, Middletown, N. Y.; Wm. Peet, F. P. Peet, Brooklyn, N. Y.; George Odyke, W. H. Odyke, Wm. H. Guion, Alfred S. Barnes, Herman Starbuck, New York; G. W. Farlie, Cresskill, N. J.; John F. Miller, Englewood, N. J.; Henry Wheeler, Philadelphia.

New York Central & Hudson River.—The following circular from Vice-President Vanderbilt bears date Dec. 11: "Mr. W. J. Van Arsdale, General Freight and Ticket Agent of the New York & Harlem Railroad, having been transferred to the Real Estate Department of the New York Central & Hudson River Railroad Company, Mr. J. H. Rutter, General Freight Agent of the New York Central & Hudson River Railroad Company, will, on and after this date, have entire charge of the freight traffic of the Harlem Company, in connection with the New York Central & Hudson River Railroad Company. Communications to be addressed to him at Room 10, Grand Central Depot.

The freight accounts of the Harlem have been transferred to the office of Mr. John F. Desmazes, General Freight Accountant of the New York Central & Hudson River Railroad Company, and all communications relating thereto are to be addressed to him at Room No. 29, Grand Central Depot.

The Ticket Department of the Harlem Company has been transferred to the office of Mr. Chas. H. Kendrick, General Ticket Agent of the New York Central & Hudson River Railroad Company, and all communications relating thereto are to be addressed to him at Room No. 6, Grand Central Depot.

The Auditing Department of the Harlem Company has been transferred to the office of Mr. D. W. Tuthill, Auditor of the New York Central and Hudson River Railroad Company, Room No. 4, Grand Central Depot. Communications to be addressed to him at that office."

Royal Land Company.—Mr. S. D. Karns is President of this company, which is building the Potomac, Fredericksburg & Piedmont Railroad in Virginia. Mr. Karns is also President of the Parker & Karns City Company.

PERSONAL.

Mr. Smith Ely, Jr., the newly-elected Mayor of New York, is Vice-President and Acting President of the Montclair & Greenwood Lake Company. He is also a member of the New Jersey Midland bondholders' committee.

Mr. Charles Piers has resigned his position as General Freight Agent of the Burlington & Missouri River Railroad in Nebraska.

A circular from General Superintendent Rowland, of the Louisville & Nashville, warns railroad managers against Frank Eustick, who lately absconded with some money intrusted to him while acting as operator and ticket agent for the Louisville & Nashville and the Louisville, Cincinnati & Lexington at Cincinnati Junction station. Eustick is described as being a telegraph operator by profession, rather good-looking, about 24 years of age, height about 5 feet 6 inches, medium build and weighing about 135 pounds; wore a slight, fair mustache and Burnside whiskers, dark clothes and soft dark hat encircled by a military cord; hair inclined to be sandy. It is thought that he went to St. Louis.

Mr. R. T. Brydon, for several years General Passenger Agent of the Ohio & Mississippi, has resigned that position.

Major C. W. Anderson has resigned his position as General Freight Agent of the Nashville, Chattanooga & St. Louis Railroad.

Mr. John E. Clark, Train Master of the Cairo & St. Louis Railroad, has resigned on account of ill health.

The resignation of Mr. Thomas D. Lovett as Consulting Engineer of the Cincinnati Southern Railroad has been finally accepted by the trustees, who also passed a resolution expressing their high opinion of Mr. Lovett's services during the four years he has been connected with this road.

Railroad Manufactures.

The Mill Bridge Company, at Toledo, O., has built new iron shops this year and will double its working facilities this winter. The works have done more this year than ever before, and are now running 14 hours daily. The company has ten gangs of men now at work outside putting up bridges.

The St. Louis Bolt & Iron Company has recently contracted to furnish the Central Pacific with 10,000 plain splice bars, 10,000 angle splice bars, and 40,000 track bolts.

The Harlan & Hollingsworth Company at Wilmington, Del., recently shipped two postal cars for the Dom Pedro II. Railroad in Brazil and four narrow-gauge passenger cars for another road in the same country. The company is building three more narrow-gauge cars for the last-named road.

Work was to be resumed Dec. 11 at the Philadelphia & Reading Coal & Iron Company's rolling mill at Reading, Pa.

Messrs. E. & G. Brooke's Furnace No. 3, at Birdsboro, Pa., last week turned out 271 tons of pig iron.

The Ironton Iron and Steel Company's furnace at Ironton, O., started up Nov. 23.

The Cambria Iron Company at Johnstown, Pa., is putting up a steel wire mill.

The Pittsburgh Manufacturer says: "The Lake Shore Rail Mill of the Cleveland Iron Company has shut down for want of orders. The works have been running on full time since Jan. 1, and on the 1st of the present month were turning out about 85 tons of finished iron rails per day."

The Pioneer Furnace, at Fosterville, Pa., has gone into blast again.

The Youngstown (O.) Register says: "The iron business in this city is about holding its own, there being no perceptible change to report. The Youngstown Rolling Mill and Brown, Bonnell & Co.'s works are running full tilt, and preparations are making by Messrs. Cartwright, McCurdy & Co. to start the Enterprise Mill this week. There is nothing discouraging in the general outlook."

The Pittsburgh & McKeesport Car & Locomotive Works, at McKeesport, Pa., recently shipped a 14-ton shifting engine for the Dunbar Furnace Company, and a 14-ton engine for a wooden railroad in the lumber district near Longview, Texas.

The Wason Company, at Brightwood, near Springfield, Mass., has orders enough on hand to keep 200 men at work all winter. The orders include passenger and sleeping cars for the Boston & Providence, the Rochester and State Line, the Chicago & Lake Huron and the Galveston, Harrisburg & San Antonio. During the present year the company has turned out 72 passenger cars, besides a large amount of car material, such as wheels, castings, trucks, etc., and has employed upon an average over 300 men.



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Editorial Announcements.

Passes.—All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.

Addresses.—Business letters should be addressed and drafts made payable to THE RAILROAD GAZETTE. Communications for the attention of the Editors should be addressed EDITOR RAILROAD GAZETTE.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns our own opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.

Contributions.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.

THE DIFFERENCE BETWEEN GOOD AND BAD FIRING.

A late number of *The Engineer* contains accounts of competitive tests made with portable engines under the auspices of several of the agricultural societies of England, their object being to supply a stimulus, by offering prizes for the best results produced, to those in charge of such engines to learn how this may be done, and thus improve themselves for the work they have to do. In one case the trials were made as follows:

An eight horse-power agricultural locomotive, constructed by Messrs. Aveling & Porter, of Rochester, was provided. This engine was fitted with a friction brake, such as is used by the Royal Agricultural Society, and a counter. The brake was loaded to 22.5 horse-power. The engine was handed over successively to the different competitors, twenty-one in number. Each man was supplied with 210 lbs. of coal and 8 lbs. of wood, and as much oil and tallow as he required was weighed out to him, the quantities being carefully noted. He was then left to fire and drive as he pleased, without interference, except to warn him that he was running his engine too fast or too slow. The standard of efficiency was the number of revolutions got out of the engine.

The result of the trials shows, what probably few persons realize, the great difference in the amount of fuel consumed if an engine is well fired and run skillfully, compared with the result if it is badly fired and run by a person who is either ignorant or careless or both. The first prize was awarded to John Waters, who ran the engine 13,967 revolutions, whereas the smallest number of revolutions obtained was 7,943. In other words, the best runner did over 75 per cent. more work with a given amount of fuel, oil and tallow than the poorest one. This result is fully explained by the manner in which they ran their engine. In the description of this trial from which we have already quoted it is said that "special attention should be called to the use made of his expansive gear by Waters, who, finding that he could do a little better with the link in one place than in another, compensated for the want of sufficiently minute divisions in the sector of the reversing lever by wedging the latter just where he wanted it." Of the other competitor it is said, "the reversing lever was frequently changed from one notch to another, and the damper was altered several times; the speed of the engine was very irregular." In other words, the one runner by careful observation and experiment had learned precisely the point at which to place the reverse lever to produce the best results—an illustration, by the way, to show the value of as

many notches in the sector as possible; whereas the other man had probably never observed these facts, or if he did, it was carelessly or inconclusively that he had no decided convictions about them.

In another trial the first prize was awarded for 10,137 revolutions; the second prize for 10,127, and the third for 10,076. But, it is said, "in order that the competitors might acquire some practical instruction, Mr. Aveling sent a trained driver of his own to show what could be got out of the engine by proper management. He succeeded in getting 12,743 revolutions, thus beating the first prize man by some 25 per cent." It is also said in the same article "that even nominally the best men would be the better of a little practical instruction, as is proved by the fact that within the last few months the consumption of fuel on the Brighton Railway has been reduced by, we believe, about 3 lbs. per mile, as a result of first pointing out to the firemen of the line the faults usually committed by them in firing, and then taking care that these faults are avoided." We have no means of knowing what the consumption of fuel is on the line referred to, but in this country it is about 38 lbs. per train mile, so that a saving of 3 lbs. per mile would be equivalent to nearly 8 per cent.

Now it would seem that such facts as these would lead to the most careful scrutiny of the consumption of fuel, that every effort would be made to reduce the consumption as much as possible. Quite curiously, excepting on some few roads, such is not the case. No account whatever is kept of the amount of coal burned by engines, so that no accurate knowledge can be obtained regarding the performance of engines. The list which is published monthly in these pages is, we regret to say, not always reliable. The service performed by engines varies of course on the different roads, and no uniform system is employed in keeping the accounts, so that for purposes of comparison the reports are apt to mislead instead of being a safe guide.

Another reason for this apparent indifference is that the control of the supply of fuel is in the hands of persons whose training has been exclusively a commercial one, who have been educated in the great School of Swap, and who are, to a very great degree, lacking in faith or power of apprehension of any kind of value excepting that which is accompanied by the signs of \$ and cts. On one road that we know of it is safe to say that the consumption of coal is nearly or quite double what it might be with intelligent management, and yet everything on that line is managed with the closest economy. There is no corruption apparent; everything is bought at the lowest cost price, and woe to the coal dealer who should charge 10 cents per ton more for coal than the market rates. In buying equipment and supplies, the whole country is canvassed for the lowest possible prices, and if a ten dollar bill should be missed from the cash drawer, official revolution would impend; and yet ton after ton of coal is wasted and escapes into thin air out of the smoke stacks of the locomotives, and is paid for in the bills for fuel. Now this condition of things exists often with what apparently is the closest and most parsimonious management. This we, believe, is because the managers are lacking in faith in the laws of science; which is often due to the narrowing tendency of the exclusive contemplation of money and barter alone. This sort of skepticism is not as rare either as may be supposed. It has required almost fifty years or more of constant assault to induce people to regard bad sewerage as injurious to life, and even at present hundreds and thousands of people will knowingly breathe air impregnated with sewer gas and not really believe that it is dangerous. In a general way they may think so—that is, that it may, perhaps, have that effect in a chemical laboratory or on people in the next street, but somehow they expect to escape. In a somewhat analogous manner, an exclusively commercial manager of a railroad feels about the consumption of fuel. Suppose it possible to make up the coal bill thus:

The Hydrogen & Carbon Railroad Co.	To Black Diamond & Co. Dr.
To coal required for transportation.....	\$12,000
" wasted by bad firing.....	4,000
" " do " badly-constructed locomotives.....	4,000

If such a bill could be made out so as to represent truly the condition of things which actually exists on many railroads, doubtless the superintendent, auditor, treasurer and president of such lines would unite in a common howl of denunciation at such waste. Yet it is extremely probable that our imaginary bill does not overstate the waste on many roads due to the causes named. All that the bill does is to state it in terms which can be apprehended by the commercial man; whereas if you tell him that one engine burns 50 lbs. of coal per train per mile and another in the same service burns only 30, or the consumption of fuel per car per mile is 1½ lbs. and in another 2½ lbs., it all appears vague and indefinite and is not "practical."

But railroad managers who are not engineers will say "this is all very well, but what shall we do? We know

nothing about locomotives, or about instructing the men who run them; and if we interfere in these matters with our master mechanic, we will probably not improve matters but only display our own ignorance." To this we say: Pursue the commercial method, the same that has been employed in keeping an account of cash for time immemorial. You know that if you receive a certain amount of money and deposit it in bank or in the cash drawer, unless the most rigid account is kept of its expenditure in the long run much of it will be wasted. This fact in business has assumed a sort of traditional authority, so that no one in his senses now questions the necessity of keeping an accurate cash account. Now when you buy coal what is done? Several thousands of tons are bought and dumped into the receptacles provided for it. That coal represents money just as much as the bits of paper that are put into your cash drawer. In the latter case the drawer is locked up, and when any money is paid out it is carefully noted and recorded, so that when the drawer is emptied it can be known exactly where the money went to. With the coal, however, no such precaution is usually taken. After being placed in the receptacle, each engine is run up to it and taken on as much as is needed. The blacksmiths with their wheelbarrows, the switchmen with their coal scuttles, all help themselves; and how many men do so without any right or authority no one knows. The exhortation which is now presented is, that an account similar to a cash account should be kept with the coal, which is a strictly commercial method of proceeding and needs no knowledge of the laws of combustion or the construction of locomotives to carry out. If this is done, and it is once learned what service is performed with a given amount of fuel, then the succeeding inquiries why some engines do so much better than others can easily be instituted with the aid of the master mechanic. Steps may be taken similar to those adopted with the portable engines in England to excite the emulation and for the instruction of firemen and locomotive runners.

With reference to the construction of the engines themselves, a similar course might be pursued by placing them on trial instead of the firemen and runners. Intercourse with master mechanics very soon reveals the fact that each one of them has an abiding belief in the great superiority of his own engines. Now we believe, that there is nothing which would do more to determine practically which form of engine does the best service than an annual competitive trial of locomotives made on the same road and under the same conditions, and by disinterested parties.

On another page we give a report of a trial made on the Boston & Albany Railroad to determine the relative economy of Mogul engines and those built by Mr. Eddy for that line. In justice we are obliged to say that the trial was made by an interested party, and although he may have conducted his experiments with the utmost fairness, it will be difficult to make the public generally have that implicit confidence in the results which it would have if the trial had been made on a road over which those interested in the performance of the engines had no authority and conducted by persons who were quite impartial. Such trials have been recommended several times in these pages, and if made they would indicate in a practical manner to those who are not experts in the construction of locomotives which are the most efficient machines; and at the same time they might be made, what was aimed at in the English trials, a means of inducing locomotive runners and firemen to improving themselves and to learn how to do better.

THE NEW YORK CENTRAL & HUDSON RIVER REPORT.

The trunk line reports are even more interesting this year than last. The competitive struggle of 1875 began early, brought down rates on the bulk of the east-bound through freight to about 25 cents per hundred from Chicago to New York, and passenger rates to \$18 from New York to Chicago and \$15 from Chicago to New York; but it closed comparatively early, and the amount of traffic moved, in spite of low rates, was not extraordinarily large. This year the contest did not begin quite so early, but it brought down freight rates to 20 cents or less as compared with 25 last year, and passenger rates to \$13 between New York and Chicago, as against \$15 and \$18 last year; and it still continues. The New York Central & Hudson River report, like that of the Baltimore & Ohio, recently issued, covers the year ending with September. This included the whole period of the railroad war last year, but not this year; and the time covered by the report during which rates were greatly reduced was not quite so long, we believe, this year as last. Other features distinguishing the two years are a much greater activity of traffic in the winter, when rates were maintained, in the latter year, and at the same time a favorable season which reduced working expenses. Nearly all reports of such railroads as report monthly showed considerably larger gross receipts and much larger net profits last winter than the previous one. These are facts to be borne in

mind in considering reports covering the two periods. The year ending with September, 1875, may be divided into three parts: a fall season of fair traffic and fair rates; a winter season of better rates but light traffic and excessive expenses, owing to the severity of the weather; and finally a spring and summer traffic large in amount, but at very low rates. The year ending with September, 1876, is better divided into two parts: a fall and winter with large traffic, usually at remunerative rates, and conducted at unusually small expense; and nearly six months of very heavy traffic at the lowest rates ever known.

Thus, there is not that presumption against the latter year which we at this time, with the lowest rates still in force and having been in force for eight months, are likely to suppose. A comparison of the years named is not at all like one of the two calendar years 1875 and 1876.

But the past year has followed one of extremely low average rates and the severest economy in expenses, and it has been distinguished by activity in passenger as well as freight traffic, all the roads, doubtless, having had much more freight to carry than ever before; but the passenger traffic, in spite of the Centennial, being extraordinarily large only on a few roads, though generally larger than in recent years. This great traffic has tested with some severity the condition of the lines on which great economies were made last year, and which might not unnaturally have been suspected of "starving" road and rolling stock in order to keep down expenses. They seem generally to have stood the test well. The number of accidents has not been unusual, and no unusual number of them have been reported as due to defects in road and rolling stock. This is not proof that the average wear has always been made good. Probably it has not. Most of the trunk lines were in that condition when the average wear could not be made good (except by a rail-renewal fund), though the track were maintained in perfect condition. They had recently been laid throughout, or nearly so, with steel, which wears so slowly that few renewals are needed for many years. Neglect of track tells very quickly, and if there was such neglect in 1875 on the trunk lines it was pretty sure to have made itself felt, both in accidents and in increased maintenance expenses, this year; and if there has been such neglect this year, the winter will probably bring it to light, especially if it is a severe one.

The first thing to be said of the New York Central report is that it appears unusually early—about a month earlier than last year, and, we believe, earlier than ever before; a commendable improvement. The business of the trunk lines is so significant as a key to the business of the country that it is especially desirable that it should be reported as early as possible.

We have presented the report, with comparisons and deductions, with unusual fullness on another page, believing that the details of earnings and expenses, especially the latter, would be of particular interest to all railroad men this year, in view of the great reduction of rates, and the experiments in economy which this company has been making during a great part of the year covered by the report. We have endeavored to present the figures so as to show results without the need of computations by the reader, to whom we commend the whole document as one of the most interesting portions of the railroad history of a remarkable and probably exceptional year in railroad business.

So far as business is concerned, the New York Central never before did so much in one year, take it altogether. Compared with the previous year, there has been an increase in both freight and passenger traffic; but the passenger traffic is but $\frac{1}{2}$ per cent. larger than the previous year, but $\frac{1}{2}$ of 1 per cent. larger than in 1873-74, and is 3 per cent. less than in 1872-73—that next preceding the panic—and indeed is but 3 per cent. greater than it was ten years ago. Up to the end of September, then, the effect of the Centennial on passenger traffic appears to have been trifling; its effect on passenger earnings, as we shall see later, was doubtless unfavorable.

But the great increase in traffic was in the freight movement, which was no less than 18 per cent. greater than the previous year, which latter showed a slight increase over that of 1873-74. The increase in freight traffic (tonnage mileage) over the year next preceding the panic (1872-73) has been more than 30 per cent., and in ten years, while passenger traffic has increased by 3 per cent., freight traffic has increased more than 300 per cent. Here, as elsewhere, it is the freight traffic which grows, and really the limit of its growth seems to be indefinite, so long as rates are reduced. This, doubtless, would not be the case were it not that there is alongside an enormous lake and canal traffic from which the railroad draws every time it reduces its rates. That is, the great growth of the railroad traffic is not due to a similar growth in the business of the country, but largely, and this year certainly chiefly, to a diversion of part of the old traffic from the water to the rail route.

This great increase in traffic was the result of a reduction of rates. The reduction in freight rates was confined almost exclusively to through traffic; that on passengers, owing to the system of Centennial tickets, to

part of the way traffic also. On the average, as the report shows, freight rates were 17 $\frac{1}{2}$ per cent. lower, and passenger 10 $\frac{1}{2}$ per cent. lower than during the previous year—a truly enormous decrease, considering that the rates of 1875 were already low without precedent. Still the freight rates were not as low on the New York Central last year as they have been on some other roads in previous years. They were just about as low during the calendar year 1875 on the Pennsylvania Railroad, and 4 per cent. lower the same year on the Lake Shore & Michigan Southern. The New York Central's immense local traffic has prevented its average receipt per ton per mile from falling as low as on several other lines, and it is this great local traffic which gives it its great strength in a competitive contest. Its through rates are probably, on an average, a little lower than on other trunk lines, as its road is a little longer. For about half of the last fiscal year it rarely received more than 0.416 cent per ton per mile on through east-bound fourth-class freight, on a large part of it never more than 0.408 cent, and often, if reports of rates accepted (by all the trunk lines) are true, a fourth less than these rates; and the great bulk of the traffic consists of this freight.

The result on gross earnings has been a reduction amounting in the aggregate to 3.4 per cent.—a little less than a million dollars. This would be an inconsiderable decrease, were it not that it accompanies a large increase in the traffic and in the work done to carry it. Much greater traffic is likely to be accompanied by greater expenses; and as the traffic produced a smaller return in gross earnings, an increase in expenses would still further reduce the net earnings.

The expenses, however, have been decreased in spite of the larger traffic, not very largely on the whole (6.6 per cent.), but in some items very largely indeed, and enough in the aggregate to more than balance the falling off in receipts, leaving a slight increase in net earnings.

The items of expenditure, and especially those showing a large decrease, will be scrutinized very closely. In the three general divisions of expenses, maintenance of road and real estate show a decrease of 29 per cent.; maintenance of machinery a decrease of 13 $\frac{1}{2}$ per cent., and expenses of working the road an increase of 4 $\frac{1}{2}$ per cent. The economy thus has been wholly in maintenance expenses.

Under the head of maintenance of road and real estate a saving of 29 per cent., amounting to \$474,000, is shown in the expenses of repairs of road-bed and other than cost of rails; while in the cost of rails the saving is no less than 80 per cent., amounting to \$608,500—the whole expenditure for rails having been but \$153,160. This would pay for about 3,000 tons of steel rails, and would renew about 40 miles or 1.6 per cent. of the company's tracks. Of course its rails have not an average life of 60 years; and the renewals do not represent the average wear of the year; but, as we have said above, this does not imply that the track has been suffered to depreciate in condition. As we know, the road has steel tracks which are comparatively new, and for several years after they were laid very few renewals are likely to be necessary, though of course they are wearing out all the time while still in perfect condition. This would not be possible with iron rails. If the road had been laid with new iron at the beginning of the fiscal year, it would hardly been possible to work it through the year without a much larger expenditure than \$153,000 for rail renewals. The progress in these two items of road-bed and rail renewals for a series of years is truly remarkable. The figures are:

Repairs of—	1872.	1873.	1874.	1875.	1876.
Road-bed.....	\$2,117,622	\$2,041,007	\$2,138,682	\$1,632,248	\$1,158,236
Rails.....	2,439,387	1,494,196	512,543	761,669	153,160

Rail renewal expenses culminated in 1872. Before that year for three years they had averaged about \$1,500,000 a year, and the use of steel had begun. The completion of renewals with steel and that of the separate freight tracks have had their expected effect on the expenses of the past three years, though of course the fall in the prices of materials and labor has also had a great effect, steel this year being less than half as high as in 1873. Of course, however, the expenditures of the earlier years were abnormally large, the renewal of steel with iron being in fact an addition to the investment in the property, though made out of earnings and charged to working expenses.

Four-fifths of the large saving in repairs of machinery in the single item of repairs of freight cars, which amounts to 23 $\frac{1}{2}$ per cent. The locomotive repairs are very little larger than last year.

One important element in the reduction of expenses has been the increase in the average load of freight trains, the striking progress in which heretofore we called attention to last year, and which is the more remarkable on this road because it is not due to the adoption of a much heavier class of engines, like the "Mogul" and "Consolidation" patterns, which have had a great effect on the average train loads on some other railroads. These average loads have increased from 103 tons in 1871-72 to 180 $\frac{1}{2}$ tons last year. For the past

three years this load has been 126 $\frac{1}{2}$, 166 and 180 $\frac{1}{2}$ tons, respectively, the increase in four years having been 75 per cent., and in two years 40 per cent. This enormous gain is due chiefly, so far as we can judge, to the separate freight tracks, permitting a uniform moderate speed for freight trains. Its importance may be judged by the fact that the very large increase of traffic of late years has been made without any increase of freight-train mileage; while the increase of more than 19 per cent. in traffic last year was accompanied by an increase of only 9 $\frac{1}{2}$ per cent. in freight-train mileage.

The expenses for working the road, as we have said, show in the aggregate a small increase (4 $\frac{1}{2}$ per cent.) There are a great many items under this head, the variations in which do not call for special attention. They will be found in our compilation of the report.

The gross earnings of this company have now decreased yearly since they reached their maximum of \$32,500,000 in 1872-73. But the decrease in expenses, which began at the same time, has been so great that a loss of \$4,450,000 in gross receipts has produced a decrease of but \$1,000,000 in net earnings. Meanwhile freight traffic has grown largely, and passenger traffic has been nearly stationary. The growth of traffic during the past year nearly made up for the great decrease in rates. Doubtless the traffic would not have been so great had the rates been higher, but doubtless, too, rates on freight as high as those of the previous year would not have diminished traffic greatly, while they would have afforded (from the same traffic) nearly \$3,700,000 greater net earnings; and if the passenger rates also had remained at the standard of the previous year the passenger business would have returned \$800,000 more, so that with the rates of 1874-75, a year of a long railroad war and of extremely low through rates, last year's business would have produced \$4,500,000 more than the actual gross and net earnings.

The Grain Movement for Thirty-two Weeks.

The shipments of grain of all kinds from the eight principal Northwestern markets for each week since April 22 have been, in bushels, by lake and by rail:

Week ending—	By lake.	By rail.	Total.	Per ct. by rail.
April 29.....	1,634,541	9,079,946	3,707,487	56
May 8.....	2,446,193	2,292,633	4,737,826	49 $\frac{1}{2}$
" 13.....	1,538,526	2,302,940	3,841,466	60
" 20.....	1,602,170	9,016,304	3,618,474	55 $\frac{1}{2}$
" 27.....	1,747,408	1,920,456	3,667,864	51
June 3.....	2,412,162	1,797,923	4,210,084	49 $\frac{1}{2}$
" 10.....	2,849,015	2,147,670	5,042,585	42 $\frac{1}{2}$
" 17.....	2,921,405	2,591,811	5,313,216	46
" 24.....	2,728,706	2,198,644	4,926,760	44 $\frac{1}{2}$
July 1.....	1,621,155	1,784,548	3,605,703	49 $\frac{1}{2}$
" 8.....	1,765,010	1,205,184	2,970,194	40 $\frac{1}{2}$
" 15.....	1,648,508	1,235,678	2,877,186	42 $\frac{1}{2}$
" 22.....	2,360,336	1,033,825	3,302,161	31 $\frac{1}{2}$
" 29.....	1,466,503	1,038,208	2,504,710	41 $\frac{1}{2}$
Aug. 5.....	9,055,948	1,283,268	3,338,511	38 $\frac{1}{2}$
" 12.....	1,744,059	1,300,720	3,044,779	42 $\frac{1}{2}$
" 19.....	2,150,392	1,614,266	3,764,548	42 $\frac{1}{2}$
" 26.....	3,362,152	1,520,811	3,872,963	39 $\frac{1}{2}$
Sept. 2.....	1,698,491	1,673,088	3,271,549	48 $\frac{1}{2}$
" 9.....	2,374,470	1,818,411	4,192,884	43 $\frac{1}{2}$
" 16.....	2,063,634	1,688,318	4,651,952	36 $\frac{1}{2}$
" 23.....	2,268,894	1,820,361	4,089,255	44 $\frac{1}{2}$
" 30.....	2,427,357	1,797,847	4,225,204	42 $\frac{1}{2}$
Oct. 7.....	3,009,394	1,680,888	4,660,252	35 $\frac{1}{2}$
" 14.....	2,580,720	1,885,991	4,366,720	42
" 21.....	2,673,647	1,800,837	4,474,484	40 $\frac{1}{2}$
" 28.....	9,635,237	1,369,160	3,904,397	34
Nov. 4.....	1,550,948	2,361,914	3,902,862	60 $\frac{1}{2}$
" 11.....	2,422,157	1,369,994	3,822,151	36 $\frac{1}{2}$
" 18.....	1,867,483	1,972,271	3,239,754	42 $\frac{1}{2}$
" 25.....	1,406,993	1,272,753	2,679,746	47 $\frac{1}{2}$
Dec. 2.....	357,374	1,376,625	1,733,999	79 $\frac{1}{2}$
Total for 32 weeks....	67,384,092	54,167,632	121,551,724	44 $\frac{1}{2}$

Lake shipments virtually came to an end for the upper lakes with the week last reported here, in which, indeed, they were only about one-fourth as great as in the preceding week. There may be later shipments from the lower lake ports—Detroit, Toledo and Cleveland—but substantially the season of navigation includes only the 32 weeks in the above table.

We have thus as the result of the season's business, during which, though lake and canal rates were never so low before, the rail rates from Chicago and Milwaukee to Eastern ports was often lower than the water rate, an exceptionally large grain movement, of which five-ninths was shipped by lake from the Northwest and four-ninths by rail.

For the same 32 weeks the receipts at the different Atlantic ports have been:

	Per cent. of total.	Per cent. All grains, of total.
New York	21,836,847	35.3
Boston	6,594,298	10.7
Portland	867,600	0.9
Montreal	3,492,681	5.7
Philadelphia	13,957,425	22.4
Baltimore	13,317,500	21.6
New Orleans	2,124,012	3.4
Total.....	61,789,293	100.0

The receipts for the last week continued large, including at New York the water shipments hurried forward toward the close of navigation, after they had almost ceased in the Northwest. Again as much larger than the average proportion was received at New York, advancing its rank slightly in corn receipts and largely in receipts of all grains; though so near the close of the season, when the totals have become so large, it requires a large number of bushels in a week to work a change in the percentage for the season. However, at this time of year receipts at Montreal almost cease, and New York's large gain in rank is accompanied by but a slight decline in Philadelphia, while Baltimore holds its own fully. Baltimore received a large quantity of wheat, which has usually gone to New York even when corn went elsewhere more freely. Of the total seaboard receipts, 30 per cent. was corn, and more than three-fourths of it went to New York.

For the week last reported the proportion of the total corn receipts arriving at each port was: New York, 47½; Baltimore, 20; Philadelphia, 17; Boston, 11½. The corresponding percentages for grains of all kinds were: New York, 67; Philadelphia, 12½; Baltimore, 11½; Boston, 5½. Montreal almost disappears, with but ½ of 1 per cent. of the total receipts, falling below Portland even.

The average weekly receipts of all grains at each port for the season of navigation (32 weeks) were:

New York.....	1,818,991	New Orleans.....	97,589
Philadelphia.....	665,829	Portland.....	30,015
Baltimore.....	529,693		
Montreal.....	355,946	Total.....	33,794,273
Boston.....	266,210		

Now for the first four weeks after the opening of navigation, New York never reached this average, and was usually one-third below it. Philadelphia on the other hand was then much above its average—about one-fifth above; while Baltimore's receipts for the same four weeks were just about its average for the whole season. Then for eight weeks—until the middle of July—came the season of the most active movement, during which New York received on the average 2,356,000 bushels weekly, or nearly a third more than its season average; Philadelphia one-quarter more than its average; Baltimore, 30 per cent. more than its average. Then for six weeks the general movement was lighter, and New York's receipts were 40 per cent. below the average; Philadelphia's, 11 per cent. below; Baltimore's, 20 per cent. below. This leaves the fall movement, extending over 14 weeks, which was generally heavy, though not uniformly so, the average receipts at all ports being 3,600,000 bushels, which is a little below the average for the whole season. During this period New York's average receipts were 6 per cent. above its season average; Philadelphia's, 15 per cent. below its average, and Baltimore 6 per cent. below its average.

Thus it has been during the fall season that there has been the greatest change in the proportions of receipts at these three ports, New York gaining and Philadelphia and Baltimore losing. This will be shown more clearly by putting the average weekly receipts at each of these ports for the 18 weeks ending with August 26 and those for the 14 weeks ending with Dec. 2 side by side, as follows:

	18 weeks to Aug. 26.	14 weeks to Dec. 2.
New York.....	1,737,646	1,923,578
Philadelphia.....	744,360	664,100
Baltimore.....	555,777	496,157
Total at three ports.....	3,038,373	2,983,841
All ports.....	3,988,492	3,660,278

In the earlier period the three ports named received 78 per cent. of the total seaboard receipts; in the later period, 81½ per cent. Of the total of receipts at the three ports named, the percentages arriving at each for the two periods were:

	First period.	Second period.
New York.....	57.2	64.5
Philadelphia.....	24.5	18.9
Baltimore.....	18.3	18.6
Total.....	100.0	100.0

Now that navigation has closed, New York loses its great advantage, the chief route by which it receives grain being obstructed until spring. Canal receipts, however, do not end with the last reported; the grain shipped on the canal from Buffalo for that week and the previous one was yet to arrive mostly. Navigation was closed for shipments, but not for receipts.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Emden & Shippenville.—Extended northeast 3 miles to Eddenburg, Pa. It is of 3 ft. gauge.

Potomac, Fredericksburg & Piedmont.—Extended westward 10 miles to a point 28 miles from Fredericksburg, Va. It is of 3 ft. gauge.

Milwaukee, Lake Shore & Western.—Extended west by north 11 miles to New London, Wis.

This is a total of 24 miles of new railroad, making 2,177 miles completed in the United States in 1876, against 1,237 miles reported for the corresponding period in 1875, 1,767 in 1874, 3,507 in 1873, and 6,885 in 1872.

Forty-Two Inch Cast-Iron Car Wheels, we learn, are now being tested by several railroad companies. The Atchison, Topeka & Santa Fe, the Flint & Pere Marquette, the Grand Trunk roads are running a few sets each, and the Lake Shore & Michigan Southern have recently ordered several sets to test. The Pullman Company has for some time been running wheels of this size, some made of cast iron and some "paper" wheels with steel tires.

General Railroad News.

TRAFFIC AND EARNINGS.

Lumber Rates to Southwestern Points.

The Southwestern Railroad Rate Association recently adopted the following rules as to lumber freights:

First.—That on and after Jan. 1, 1877, they will carry lumber, lath, shingles, etc., at actual weight only, to competitive as well as local points.

Second.—That 20,000 pounds shall be considered as a car-load, and 24,000 pounds shall be the limit to which any car shall be loaded—the excess above the last-named weight in any one car to be removed.

Third.—That, as far as practicable, the cars will be weighed previous to loading, in order that an accurate weight of the lumber may be had. Station agents will be required to insert in the way-bills the correct weight of all lumber shipped from their respective stations, and general freight agents will be instructed to revise and adjust lumber tariffs to conform to these resolutions, giving a rate per 100 pounds, as upon other classes of freight.

Fourth.—That window-frames, sash (glazed or unglazed), doors, blinds, and like manufactured articles, shall not be carried in the same cars with rough lumber at lumber rates.

A number of companies not in the association have been

asked to concur in these rules, and several of them have signified their intention of doing so.

Railroad Earnings.

The following are from reports made to the Secretary of the Treasury for the year ending June 30, 1876:

Central Branch, Union Pacific.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$114,414	\$131,500	\$17,086	\$1,144	114.9%

Other earnings for various periods are reported as follows:

Year ending Sept. 30:

Boston & Maine.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$187,76.	\$187,75.	\$0.	\$0.	0.0%

New York Central & Hudson River.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$28,046	\$28,218	\$0.	\$0.	0.0%

Hudson River.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$28,046	\$28,218	\$0.	\$0.	0.0%

New York, New Haven & Hartford.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$4,314,682	\$4,599,523	\$28,841	6.3	6.4%

Potomac.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$1,241,72	\$1,262,108	\$1,137,926	6.6	6.4%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

Michigan Central.....	Earnings. Expenses. or deficit. per mile.			
	Net earn.	Earn.	P.c. of	exp.
\$2,000,00	\$2,000,00	\$0.	\$0.	0.0%

insurance rates, with nearly all the expenses of operating a vessel, are higher. Hence it is generally expected that round prices will be paid in the late Fall. But the following exhibit, giving the average freight for a series of years on wheat and corn by lake for November, and the average by canal on the same cereals, shows that rates have ruled ruinously low in the best month this year:

Years.	Lake.		Canal.	
	Wheat. cents.	Corn. cents.	Wheat. cents.	Corn. cents.
1867.	9.0	7.0	19.1	16.3
1868.	9.3	8.3	19.2	16.2
1869.	10.3	9.8	21.7	19.0
1870.	8.5	7.6	11.9	11.5
1871.	10.1	9.7	15.9	14.1
1872.	12.4	11.4	16.0	14.0
1873.	7.4	6.9	12.3	10.6
1874.	4.6	4.2	9.7	8.7
1875.	5.9	5.6	10.5	9.1
1876.	3.7	3.3	7.5	6.9

"From this it will be seen that the average for last month was the lowest that has prevailed during any preceding November in the past ten years. These freights are barely enough to pay the working expenses of large-class economical vessels. For small schooners they are almost absolutely ruinous. The cause of this depression is the competition of the railroads."

Texas Cotton by Rail.

The St. Louis *Republican* says: "The St. Louis, Iron Mountain & Southern Railroad has recently concluded a contract to transport 10,000 bales of cotton from Galveston, Texas, to New York city. This is an almost unheard of large shipment of cotton such a distance by rail. At an average of 33 bales to a car, it will take 300 cars to complete the work."

Hog Packing.

For the first month of the packing season, Nov. 1 to Dec. 2, the number of hogs packed in the Northwest is reported as follows:

	1876.	1875.	Increase, P. c.
Hogs packed.	1,489,517	1,454,448	45,069 3.0

Chicago shows an increase of 12 per cent.; Cincinnati a decrease of 35 per cent.; St. Louis an increase of 70 per cent.

Petroleum Movement.

For the 11 months ending Dec. 2 exports were as follows, in gallons:

	1876.	1875.	Inc. or Dec.	P. c.
New York.	129,978,183	136,981,142	Dec.	6,053,959 5.1
Boston.	2,684,978	2,447,097	Inc.	237,881 9.7
Philadelphia.	60,554,674	61,040,468	Dec.	485,794 0.7
Baltimore.	35,671,774	24,244,923	Inc.	11,426,851 47.0

Total. 228,889,559 224,663,630 Inc. 4,226,929 1.9

There has been but little variation in the total exports for four years, the exports this year being but about 1 per cent. greater than in 1873. The exports from New York were 61 1/2 per cent. of the total in 1873, 64 per cent. in 1874, 61 per cent. in 1875, and 56 1/2 per cent. in 1876. Baltimore exports, which were 1 1/2 per cent. of the total in 1873, became 2 1/2 in 1874, 10 1/2 in 1875, and 15 1/2 in 1876.

RAILROAD LAW.

Vermont Railroad Legislation.

At its recent session the Vermont Legislature passed a law authorizing the authorities of any town or city, on petition of a railroad company, to commission such of its employees as may be designated as railroad police. Notice of their appointment is to be filed with the Secretary of State, and they may be removed by the town authorities or company upon due notice. They shall wear badges to designate their authority and have all the usual powers of constables or policemen upon the trains and premises of the road. Persons arrested by them on the cars may be carried to any town or city not more than 20 miles from the place of arrest. The law also provides a fine of from \$2 to \$20 for loitering about a depot, and a fine of from \$2 to \$20 for refusing to pay fare on the cars.

Another law provides that the penalty for misplacing a switch, removing a rail or obstructing a track shall be not less than two nor more than 20 years' imprisonment at hard labor. If any person shall be hurt in consequence of such act, the term may be increased by not more than 20 years.

An amendment to the general law provides a fine of not more than \$500 for any person who shall run a locomotive upon the tracks of a road without due authority or permission from the company. If such action shall cause a collision whereby life is lost, the unauthorized runner may be held for manslaughter.

Another amendment provides that no judge shall be disqualified to sit in a railroad case, no officer of court shall be disqualified from acting, and no citizen be prevented from serving on a jury or a commission to condemn lands by reason of being a citizen or a tax-payer in a town holding stock in the railroad company which is a party in the case.

Lastly, a new law provides that any telegraph company may put up its line on or through land belonging to a railroad company on payment of a reasonable compensation. If the amount of compensation cannot be fixed by agreement, commissioners shall be appointed to decide the question in the same way as for the condemnation of lands.

Net Earnings of Railroads.

A dispatch from Des Moines, Ia., says that in the United States Circuit Court, Dec. 8, Judge Miller gave his decision in the suit of the United States against the Sioux City & Pacific Company. The suit was to recover 5 per cent. of the net earnings under the provisions of the law of 1862 granting aid to the various Pacific railroads, and the Court decided that, in ascertaining the net earnings, interest on bonds must be deducted, as well as working expenses and repairs. As in this case the surplus earnings over working expenses were not sufficient to pay the interest, the suit was dismissed.

Vermont Railroad Tax Law.

The tax law passed by the Legislature of Vermont at its recent session provides that the real estate belonging to any railroad company shall be assessed the same as any other property. The road-bed and track shall be considered real estate, but shall not be assessed at more than \$2,000 per mile. The real estate of a railroad company in any town shall be exempt from taxation for five years after the completion of the road into or through that town and the first running of regular trains. Power is given to collectors to levy on any personal property of a company for unpaid taxes.

ANNUAL REPORTS.

New York Central & Hudson River.

The report to the State Engineer and Surveyor for the year ending with September last was filed last Tuesday, a month earlier than last year. The following gives the figures of the report accompanied with those for the previous year.

The property consisted of the same lines both years, namely, the New York Central & Hudson River Railroad from New York by way of Albany to Buffalo and Suspension bridge, with branches and loop lines, and the leased New York & Harlem Railroad, from New York northward to Chatham, the only changes being in some additional sidings, etc.

The mileage of main and other tracks was as follows at the close of the last year:

	Owned.	Leased.
Length of road.	740.17	260.03
Second track.	465.30	49.96
Third track.	235.69	3.85
Fourth track.	232.19	3.85
Turnouts.	414.60	37.35
Total.	2,077.95	355.04
Total track worked.		2,432.99

Compared with the previous year, this shows an increase of 4 miles in third track owned and of 31 miles in turnouts owned and an increase of 3.85 miles in third track, the same of fourth track, and 7.9 miles in leased turnouts—a total increase of 35 miles of track owned and 15.9 miles of track leased.

The total mileage of road worked—main line and branches, is 1,000.2 miles both years.

The equipment at the close of the year consisted of:

	Locomotives.	557
Dummy engines.		8
First-class passenger cars.		416
Second-class and emigrant cars.		83
Baggage, mail and express cars.		215
Freight cars.		15,310

Compared with the stock at the beginning of the year, this shows an increase of two second-class and emigrant and 713 freight cars, and a decrease of one locomotive, 11 first-class passenger cars, and 7 baggage, mail and express cars.

This property is represented by:

	Capital stock.	\$89,428,300 00
Funded debt.		39,844,723 33
Bonds and mortgages given or assumed by the company upon purchase of real estate.		556,540 88

Total (\$175,445 per mile of road owned). \$129,829,564 21

Compared with the previous year, there is no change in the capital stock, a decrease of \$155,944.29 in the funded debt reported, the first appearance of the real estate mortgage debt as a separate item, and the disappearance of the floating debt of \$1,167 reported last year. The real estate mortgage debt, which is not a lien upon any part of the road, existed last year, but was then included in statement of funded debt. The total debt then was \$40,004,834.62 at the beginning of the last fiscal year, and \$40,401,264.21 at its close, the increase being \$396,429.59—not quite 1 per cent.

The cost of road and equipment is given as follows:

	By last report.	By present report.
For graduation and masonry.	\$19,945,934 75	\$19,423,106 83
For bridges.	2,495,404 17	2,526,026 21
Superstructure, including iron.	28,564,425 68	28,826,925 68
Passenger and freight stations, buildings and fixtures; engine and car houses, machine shops, machinery and fixtures.	11,032,457 18	11,654,886 78
Land, land damages and fences.	11,682,936 63	11,812,743 36
Locomotives and fixtures, and snow ploughs.	5,660,903 51	5,628,903 51
Passenger and baggage cars.	1,793,345 82	1,780,143 82
Freight and other cars.	9,547,701 93	9,940,401 93
Engineering and agencies.	2,999,473 27	2,999,473 27
Horses.	16,986 00	16,985 00
Harness and stable equipage.	4,293 10	4,293 10
Rochester & Lake Ontario Railroad.	150,000 00	150,000 00
Buffalo & Niagara Falls Railroad.	658,921 56	658,921 56
Leviston Railroad.	400,000 00	400,000 00
Saratoga & Hudson River Railroad.	2,000,000 00	2,000,000 00
Total cost of road and equipment.	\$96,355,774 50	\$97,822,811 05

The changes here are the following increases:

For graduation and masonry.	\$77,172 08
For bridges.	28,622 04
Superstructure, including iron.	262,500 00
Buildings, machinery and fixtures.	622,429 60
Land, land damages and fences.	120,812 83
Freight cars.	302,700 00

Total increases. \$1,513,236 55

And the following decreases:

Locomotives and fixtures and snow plows.	\$32,000 00
Passenger and baggage cars.	13,200 00

Total decreases. \$45,200 00

Balance of increase in construction account. \$1,468,036 55

This increase is \$1,071,000 greater than the increase in stock and debt.

The increase in cost of sub and superstructure is less than \$10,000 per mile of new track; the addition to the cost of freight cars is at the rate of \$550 per car added to the stock. The expenditures on the extensive new shops at East Buffalo and the grain elevator in New York doubtless absorbed most of the addition to the buildings account.

The work of the last two years has been:

Train mileage:	1875-76.	1874-75.	Inc. or Dec.	P. c.
Passenger.	4,743,485	4,563,688	179,797	3.9
Freight.	9,278,266	8,457,816	820,450	9.7
Work and switching.	4,224,866	3,177,347	47,482	1.1
Total.	18,246,607	17,198,878	1,047,729	6.1

No. of passengers carried:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Through first-class.	122,025	91,453	30,572	32.0
Way first-class...	8,147,501	8,350,395	202,544	2.4
Way commuters...	995,370	991,544	33,928	3.5
Through emigrant...	10,724	13,737	3,015	22.0
Way emigrant...	5,622	5,500	123	2.2
Total.	9,251,490	9,422,629	141,139	1.5
Tons carried...	6,903,680	6,001,954	801,726	13.3
Passenger mileage...	353,136	338,934,360	14,201,785	4.2
Tonnage mileage...	1,674,447	1,404,008,029	270,439,026	19.3

coat, 1; overcoat, 1; paper collar, 1 (clean); Centennial neck-tie, 1. His hat carried a signal of distress, consisting of a bunch of flaming red hair sticking through the crown. The hack drivers all wanted him to take a carriage; the omnibus collector said he had a bus just leaving for the Palmer, and the Massasoit House man vociferated, "Meals 50 cents," in his most gentlemanly manner. Turning a deaf ear to their blandishments, the stranger, with touching confidence, walked up to Dan and asked him to direct him to the ticket-office. Dan winked both eyes at the boys, and showed him the way with the most engaging politeness. Peacefully dodging the various pitfalls for strangers, in the shape of apple-women, etc., he at last arrived at "Window 8."

"Say, stranger, do you recollect I kin git ter go to California right soon?"

"Yes," responded the Great Mogul; "in fifteen minutes."

"What brought the fare be? Cap'n?" was the next question.

"It might be a thousand dollars, but it aint. The way you want to go is \$88."

"That's right cheap, now, ain't it?" turning to the crowd which had gathered around him. "I say, stranger, ain't you got some tickets that'll give a feller a right good ride into the kee boxes—something real nice, yer know? Yer see I just come up from Indeanny, last nite, and I want to travel real good, yer see. I don't reckon I'll mosey round much more, and I want suthin'—"

"Say, mister, jus' pull yer ves!" suddenly shouted Logan in his ear.

"Don't reckon I need ter. Jest give me a ticket on one uv them shiny kee boxes what has beds into 'em. Tell yer what, stranger, I kilkilate to mosey long in style this yer time 'f I never do again. Yer see, I just cum from Indeanny, yer know, and I reckon I'm a goin' to pike a right smart of a ways 'fore I kin git to Califony. How long 'fore I kin git to go?"

"Here's your ticket to San Francisco with sleeping-car, clear through, \$156," said the ticket agent.

The "Indeanny" man reached to the bottom of the pocket in his shirt, hauled up a big cloth tied up with a section of a steamboat bawser, untied it, and from a big roll of greenbacks selected a \$500 bill, which he handed to the agent, remarking at the same time, "I don't wear very good clo's, boys, but I kilkilate to allers have enuff money to pay my way."

Immediately every one was as polite as a peeler who is afraid he is about to be discharged.

Logan wanted to carry his valise to the car, and Ed., the nuboy, tried to sell him a prize package; but he resisted all their blandishments, and inquired for the baggage-room, remarking that he had "two carpet sacks and a basket of per-*visshun thar*" that he wanted checked. He was shown the way, and he vanished from the sight of the ticket-agent on the straight road to the baggage-room; and now that gentlemanly ticket-agent has on hand a counterfeit \$500 bill, which he will dispose of at the lowest market rates. He has also notified conductors to look out for San Francisco first-class ticket 10-375. The "Indeanny" man has gone to St. Louis to recuperate.—*Quincy Whig.*

Low Priced Railroad Stock.

The Atlanta (Ga.) *Constitution* says: "Yesterday Jones, Ellis & Co., sold the property of George W. Camp, bankrupt, of Carroll County. After the land was bought, they sold 129,98-100 shares of the capital stock of the Savannah, Griffin & North Alabama Railroad for \$26 to W. H. Patterson. The price for the railroad stock may seem low, but it is the general price. We heard of twenty shares of other stock in the same road being offered for half a dozen oysters on the half shell."

We recall another case where 100 shares of stock of a Connecticut railroad were traded for a dog, and the new stockholder afterwards complained that he had the worst of the bargain.

OLD AND NEW ROADS.

Potomac, Fredericksburg & Piedmont.

The Royal Land Company, which lately purchased this road, formerly the Fredericksburg & Gordonsville, has now 28 miles of the line from Fredericksburg, Va., completed and in running order, and 10 miles more, to Orange Court House on the Virginia Midland, are ready for the rails. The company has also purchased the Shenandoah Valley & Ohio road and will build it from the coal mines near Harrisonburg to Orange Court House, making a narrow-gauge line about 100 miles long from Harrisonburg to tide-water. The company owns 200,000 acres of valuable coal lands in the Shenandoah Mountains and owns and controls a large body of land rich in hematite and other iron ores. The company intends, as soon as the road is completed from Fredericksburg to Orange Court House, to put a mortgage upon its entire property, under which 8 per cent. bonds, having 30 years to run, will be issued to provide means for the completion of the road.

Fast Mail Trains.

The Post Office Department has arranged for a partial renewal of the fast mail service, which will begin Dec. 18. After that date the Pennsylvania newspaper train will carry a mail which will be continued through to Washington, reaching that city at 1 p. m. The train will also carry mail for the morning express west from Philadelphia, which serves a large part of Eastern Pennsylvania with mail matter. Postal cars will also be attached to the Western express leaving New York at 6 p. m., and to the express leaving St. Louis at 8:30 a. m., which will secure better time than has lately been made between the two cities.

Atchison, Topeka & Santa Fe.

This company's report of earnings for October is as follows, on 711 miles worked:

Freight	219,736	01
Passengers	70,882	18
Express, mail, etc.	7,339	57
Total (\$419 per mile)	297,957	76
Working expenses (30.97 per cent.)	119,080	29
Net earnings (\$252 per mile)	178,877	47

As compared with October, 1875, there is an increase of 49 per cent. in gross and of 58.7 per cent. in net earnings; the mileage worked was 929 miles last year. For the ten months ending Oct. 31 the road earned \$2,056,342.08 gross and \$1,074,525.62 net on average of 694 miles worked, being an increase of 73 per cent. in gross and 63.3 per cent. in net earnings with an increase of 32 per cent. in mileage.

St. Louis Fast Trains.

On Dec. 11 the companies interested began to run a through train between New York and St. Louis by the New York Central, the Lake Shore and the Toledo, Wabash & Western. This train will be known as the "Special St. Louis Express," will leave New York at 8:30 a. m., and will make the run of 1,170 miles to St. Louis in 36 hours. A fast train will also be run in connection with this from Cleveland to St. Louis by the Cleveland, Columbus, Cincinnati & Indianapolis and the Vandalia Line, arriving in St. Louis about the same time as that going by Toledo.

Auction Sales of Railroad Securities.

In New York, Dec. 7, at auction, Carolina Central first-mortgage bonds brought 15; second-mortgage bonds, \$2,522,000, face value sold for \$200. Denver & Rio Grande first-mortgage bonds brought 56 1/2; Toledo, Canada Southern & Detroit first-

mortgage, 38 1/2; Chesapeake & Ohio first-mortgage, 28; West Wisconsin first-mortgage, 52 1/2; New Orleans, Mobile & Texas first-mortgage, 5; Kansas Pacific, first mortgage Denver Extension, 37; Sioux City and St. Paul first-mortgage, 35; Boston, Hartford & Erie stock, \$100 face value, 16 cents per share. In New York, Dec. 9, Toledo, Peoria & Warsaw Western Division second-mortgage bonds brought 30; Rockford, Rock Island & St. Louis first-mortgage bonds, 17 1/2.

Wisconsin Central.

This company began to run regular trains on its through Lake Superior Line Dec. 11. The distance from Milwaukee to Ashland is 351 miles, of which the completed rail line from Milwaukee to Butternut Creek is 297 miles; stage line from Butternut Creek to Chippewa River, 12 miles, and rail from Chippewa River to Ashland, 42 miles. A through freight line has also been organized, with transfer by teams. The 12-mile gap in the road is to be filled up early in the spring.

Pennsylvania.

The New Holland Extension of the leased East Brandywine & Waynesburg road has been accepted by the company's engineers and settlement made with the contractors. Trains will be put at once on the extension, which is 11 miles long, from Waynesburg westward to New Holland in the Conestoga Valley.

The company has assumed direct management of the ferry between Camden and Philadelphia, which is owned by a separate corporation, which has been, however, controlled by this company. Two new boats are to be built and improvements made in the landings.

Chicago, Burlington & Quincy.

The main line of the recently acquired St. Louis, Rock Island & Chicago road will be worked as a separate division of this road, with division headquarters at Rock Island, Ill. The branch of the same road from Sagetown to Keithsburg will be worked as part of the Galesburg Division.

Notice is given that the trustees under the land grant mortgage of the Burlington & Missouri River Railroad will receive, at the office of John N. Denison, Assistant Treasurer, until Dec. 23, proposals for the sale to them of cash of \$200,000 of the bonds issued under the mortgage.

Ithaca, Auburn & Western.

The owners of this road, formerly the Western Extension of the New York & Oswego Midland, have resolved to complete it by an extension from Scipio Center, N. Y., northward to Auburn, 11 miles, and also to build a branch from South Lansing to Ithaca, 8 1/2 miles. The contract for both these extensions has been let to a well-known contractor, Mr. Grinnell Burr, of Warwick, N. Y., who is to build them complete and agrees to take the greater part of his pay in the securities of the company.

Meetings.

The following companies will hold meetings at the times and places given:

Central, of Georgia, annual meeting, at the banking house in Savannah, Ga., Dec. 19, at 10 a. m.; annual election, at the same place, Jan. 1, at 10 a. m.

Cleveland & Pittsburgh, annual, at the office in Cleveland, O., Jan. 3.

Ohio & Mississippi.

The following notice, signed by Joseph W. Alsop, G. Warren Smith and Wm. D. F. Manice, Committee, appears in the New York papers:

"After an informal meeting of bondholders and stockholders of this company, the undersigned, having been nominated a Committee of Safety and Protection in reference to the present peril of our interests by the secret institution of suits placing the railway in the hands of Receivers, hereby request all holders of bonds and stocks of said company to call at the office of Day & Heaton, No. 29 New street, New York, without delay, for important information and co-operative action."

Dividends.

Dividends have been declared by the following companies:

Chicago & Northwestern, 2 1/2 per cent., on the preferred stock, payable Dec. 26. Transfer books are closed from Dec. 14 to Dec. 26.

New York Central & Hudson River, 2 per cent., quarterly, payable Jan. 15. Transfer books are closed from Dec. 15 to Jan. 20.

Consolidation Coal, 2 1/2 per cent., payable Jan. 2.

American Express, \$8 per share, semi-annual, payable Jan. 2.

Augusta & Savannah (leased to Central, of Georgia), 3 1/2 per cent., semi-annual, payable on demand.

Union Pacific, 2 per cent., quarterly, payable Jan. 1.

Western Union Telegraph, 1 1/2 per cent., quarterly, payable Jan. 15.

Chicago & Iowa.

The sum of \$72,200.81 having become applicable to the purchase of bonds of this company under the traffic contract between it and the Chicago, Burlington & Quincy, bondholders are invited to send proposals for the sale of their bonds to John N. Denison, Trustee, Boston, Mass., until Dec. 27.

Denver & Rio Grande.

This company's November report is as follows for the Main Line, 120 miles:

Passenger earnings.....	99,961	51
Freight.....	20,170	90
Miscellaneous.....	75	00

Total (\$252 per mile)..... \$30,207 41

As compared with November, 1875, there is a decrease of \$203.40. Of the total this year \$1,118.78 was from mails and Government business. To these gross earnings are to be added hereafter whatever the referee may award as this company's proportion of earnings on competitive business under the agreement. The earnings of the Trinidad Extension for the month were \$13,929.45.

Atlantic & Great Western.

On suit of Kohn Reinach, of Amsterdam, Holland, the New York Supreme Court has granted an injunction restraining L. H. Meyer, F. Schuchardt and H. W. Smithers, trustees, from taking any further action to secure the proposed extension for three years of the so-called Ohio bonds, which are a first lien upon the road in Ohio, and the principal of which became due in October.

Parker & Karns City.

A correspondent writes as follows of this road and its lately completed extension from Karns City, Pa., to Butler:

"The route of this road is through the heart of the oil regions of Butler County; it is estimated that within three miles of the road on either side, within its length of 28 miles, 20,000 barrels of oil are produced daily, and owing to the large population the gross earnings are almost equal to those of the main stem of the Denver & Rio Grande, 120 miles long. To the President, S. D. Karns, and Superintendent, W. C. Mobley, the road owes its origin and success, Mr. Karns owning half the entire line."

Louisville, Cincinnati & Lexington.

The postponement of the sale of this road was made on petition of a number of persons and corporations who are parties to the suit as claimants against the company. The reason for the postponement is that several important points affecting the standing of these claimants are before the Kentucky Court of

Appeals on appeals from the Chancellor's decisions. The sale will probably not take place until these questions are decided.

The Receiver's report for November is as follows:

Balance, Nov. 1.....	442,760	31
Receipts from all sources.....	132,636	72
Total.....	\$615,297	03
Audited vouchers and pay-rolls.....	\$126,912	01
Back pay claims.....	138	45
		127,050

Balance Dec. 1..... \$488,246 57

The receipts exceeded the disbursements by \$4,486.26 for the month.

Chicago, Clinton & Western.

It is reported that all difficulties have been adjusted and that work will be pushed on this road as fast as the ties and rails can be delivered.

Providence & Boston.

The survey for this projected narrow-gauge road is nearly finished, the line being located from Boston to Valley Falls, R. I. It is west of the Boston and Providence and about half way between that road and the New York & New England.

Marietta & Cincinnati.

The County Commissioners of Marietta County, Ohio, have begun suit to enjoin this company from taking up the rails from the old road between Marietta and Athens. Since the completion of the Baltimore Short Line the old road has been almost given up, only a tri-weekly mixed train being run over it, and it has lately been reported that the company was about to abandon it altogether.

Cincinnati, Rockport & Southwestern.

The officers of this company are reported to be considering the question of changing their road from standard to 3 ft. gauge, with a view to a connection with the projected Bedford, Brownstown & Madison narrow-gauge road.

Lehigh Valley.

The *Official Guide* for December says: "All ticket reports for both this road and for the Geneva, Ithaca & Sayre Railroad should be addressed to A. W. Nonnenmacher, Ticket Accountant, Mauch Chunk, Pa.; but communications in reference to other passenger business should be addressed to William H. Sayre, General Agent, Bethlehem, Pa. Passenger-car mileages will be reported to William H. Sayre, General Agent Lehigh Valley Railroad, Mauch Chunk, Pa. Freight-car mileages to John Taylor, General Freight Agent Lehigh Valley Railroad, Mauch Chunk, Pa. Coal-car mileages to William C. Morris, Jr., Cashier Lehigh Valley Railroad, Mauch Chunk, Pa. All other accounts should be sent to John B. Garrett, Auditor, No. 238 South Third street, Philadelphia. Balances due other companies for car service, and interchange of passenger and freight business, will be settled by voucher from the Auditor's office."

Macon & Brunswick.

Messrs. E. A. Flawell, W. A. Lofton and George S. Jones, State directors, offer for sale or lease this road with all the equipment and appurtenances, now the property of the State of Georgia. The road extends from Macon, Ga., southeast to Brunswick, 186 miles with a branch from Cochran to Hawkinsville, 10 miles. Any information required will be furnished on application to the directors at their office in Macon. Sealed bids for the lease or purchase of the road will be received until Jan. 23, 1877. Payment, in case of purchase, may be made in cash, Georgia State bonds, or Macon & Brunswick bonds endorsed by the State under the act of Dec. 3, 1866.

In order to secure a share of the Florida business, this road began on Dec. 1 to run a through train from Macon to Brunswick, connecting at the last-named place with a steamboat line to Fernandina, Fla. At Fernandina connection is made with the Atlantic, Gulf & West India Transit Company's road, and trains run through to Jacksonville, the central or distributing point for Florida travel. The steamboat passage from Brunswick to Fernandina is made by the inside route, not requiring a sea trip. Arrangements have been made for through tickets over the line either from Brunswick or Jesup, the Atlantic & Gulf crossing, with all connecting lines. In connection with the lines north and west of Macon through trains are also run to Jacksonville by the all rail route.

Mr. Henry M. Drane, General Passenger and Ticket Agent of the road, has issued a circular giving distances, etc., on the various routes to Florida, which will doubtless be very convenient to connecting lines in making up accounts, presenting much information in a condensed form.

Philadelphia & Reading.

The Philadelphia correspondent of the New York *Bulletin* notes a rumor that negotiations are in progress between this company and the Baltimore & Ohio, having for their object the transfer to the latter company the leases now held by the Reading of the Reading & Columbia road and the Susquehanna Canal from Columbia to Havre de Grace. The object of the Baltimore & Ohio is said to be the acquisition of a line to the anthracite regions of Pennsylvania. A very considerable coal business is now done over the Reading & Columbia road and by boat down the canal to Havre de Grace and thence to points on Chesapeake Bay. The lease, however, would give the Baltimore & Ohio only the water connection, as it has no rail connection with Columbia.

Chesapeake & Ohio Canal.

The cold weather of Dec. 9 and the following days closed this canal to navigation. Some 75 boats were frozen in on the canal, but some of these may work their way out if milder weather should come this week.

Chicago, Danville & Vincennes.

The company and James A. Elwell, trustee, have taken an appeal to the United States Supreme Court from the decree of foreclosure. The points on which the appeal is taken are: 1. Whether the Court could set aside the funding contract of November, 1873.

2. Whether the Court could decree the principal of the bonds due.

3. Whether, under Illinois law, the Court can by its decree take away the equity of redemption.

4. Whether the Court can transfer the franchises in Illinois to the purchasers under the decree.

The appeal will operate to stay the sale until the Supreme Court decides the question. The points taken are principally technical and do not affect the equity of the case.

Chicago, Danville & Vincennes.

In the United States Circuit Court at Chicago, Dec. 5, decree of foreclosure under the respective first mortgages were ordered to be entered for the Illinois and Indiana divisions of this road. The decree for the Illinois Division sets forth that there are due seven semi-annual coupons of \$87,500 gold, each, with interest from date of maturity, and also \$2,500,000 in gold for the principal of the bonds. In case the company does not pay these amounts in full within 20 days, Henry W. Bishop, Master in Chancery, is directed to sell the property in Chicago, at public sale, after giving 30 days' notice. The property includes the main line from Dolton, Ill., to Danville, 108 miles, with the branch from Bismarck to the Indiana State line, 4.6 miles; all real estate, depots, shops, etc.; the terminal property, switches and yard in Chicago; the leasehold rights to the Chicago & Southern and the Pittsburgh, Cincinnati & St. Louis

tracks from Dolton to Chicago; certain real estate in Chicago; the equipment, consisting of 25 engines, 6 passenger, 3 baggage and 3 mail cars, 246 box, 34 stock and 436 coal cars, and all the franchises, rights, etc.

The Indiana Division decree sets forth that there are due seven coupons, \$52,500 gold each, with interest, and \$1,500,000 gold, principal of bonds. If these are not paid in 20 days, J. D. Howland, Master in Chancery, will sell the property in Indianapolis, at public sale, on 30 days' notice. The sale will include the completed line from the Illinois State line to Snoddy's Mills, Ind., 19.5 miles, with 1.63 miles of coal branches; the partly completed line from Snoddy's Mills to Brazil, 43 miles; all real estate and buildings; 4 engines, 1 passenger and 1 baggage car, 2 cabooses, 33 box, 6 stock and 75 coal cars, and all the franchises, etc.

The terms of sale of both divisions are 25 per cent. in cash on the day of sale, one-half the balance in three months and the rest in six months. The proceeds of the sale are to be applied, first, to payment of court costs and expenses of sale; second, to payment of all liabilities incurred by order of court while the road was under its charge, and, finally, to payment of the bondholders, first applying on the funded coupons all the money received thereon under the various funding schemes, as of the date when such payments were made. The sales will take place about the end of January.

Carolina Central.

This road has passed into the hands of receivers on application of the creditors. The company has been in embarrassed circumstances for some time, and the present action was generally anticipated. The road extends from Wilmington, N. C., west by north through Charlotte to Shelby, 241 miles. It was formerly the Wilmington, Charlotte & Rutherford and was sold under foreclosure some four years ago and bought in by the bondholders, who organized the present company and completed the road.

Jersey Shore, Pine Creek & Buffalo.

It is reported that parties interested in the Philadelphia & Reading have secured control of this road and that work will be resumed in the spring. The road, on which some grading has been done, is intended to run from Williamsport, Pa., northwest to a connection with the Buffalo, New York & Philadelphia near Port Allegany.

Richmond, Fredericksburg & Potomac.

The adjourned annual meeting was held in Richmond, Va., Nov. 28, when the annual report was submitted and referred to a committee, with instructions to report thereon to an adjourned meeting to be held Dec. 13.

Salt Lake City & Coalville.

The construction of a narrow-gauge road from Salt Lake City, Utah, to Coalville by way of Park City is strongly advocated, and several meetings have been held to devise a plan for its construction. Most of the coal supply of Salt Lake comes from the Coalville mines and is carried by the Union Pacific and Utah Central roads. It is charged that the former company does not give the facilities for the traffic which it ought to do, and that the business is embarrassed in consequence.

Texas & Pacific.

The San Diego (Cal.) *World* says that the new line as surveyed and located from San Diego to Fort Yuma is as follows: "Starting from town, the line runs through National City, thence crossing the Sweetwater through Telegraph canyon to the lower end of the Jamul valley; thence by Harrison's ranch to Cottonwood at the mouth of Bear valley; thence up Bear valley through Moreno canyon into the Mataquequa chain of valleys, through which a decidedly light and easy line has been discovered, to the head of Lajos Valley, taking the side hill down, and, on getting up, taking the top of the mountain at the head of Miller's valley and running level on the crest and crossing Walker's summit, thence through Walker's River canyon to the head of Cariso canyon; thence through Cariso Creek canyon and Palm Tree Creek canyon to the desert; thence straight across the desert to Yuma, shortening the route materially—the maximum grade being two feet in one hundred."

The *World* is also informed that work on this line will be begun at once and continued until the cars are running to Fort Yuma.

Milwaukee, Lake Shore & Western.

The extension from Appleton, Wis., west by north to New London, 21 miles, is completed and regular trains began to run to New London, Dec. 10. Work has been begun on a depot and other necessary buildings in that town. Connection is made there with the Green Bay & Minnesota road.

Emmorton & Shippenville.

The track of this road is now laid from the Allegheny Valley road at Emmorton, Pa., northeast to Edensburg, about eight miles. Edensburg is the principal town of the Clarion oil region and the line is expected to have a large traffic in carrying oil from that point to the Allegheny Valley road. It is of 3 ft. gauge.

Bronx & Rio Grande.

The contract for grading the extension of the La Veta Branch from La Veta, Colo., to Fort Garland, 35 miles, has been let to Carlile, Orman & Mersereau, of Denver. The firm will at once put a considerable force on the work, which is to be done by May 1, 1877.

New Brunswick & Canada.

It is said that the gauge of this road is to be changed from 5 ft. 6 in. to 3 ft. 6 in., which is the gauge of the New Brunswick Railway and also of the Grand Southern, which is now under construction, and which will be the principal connection of the New Brunswick & Canada. The road runs from St. Andrew, N. B., north to Woodstock, 93 miles, with branches from Debuc, N. B., to Houlton, Me., eight miles, and from Watt Junction to St. Stephen, 19 miles.

Connection Western.

A meeting of the bondholders was held in Hartford, Conn., Dec. 6, to consider the condition of the company's affairs. The company presented a proposition to fund four years' coupons in new 7 per cent. bonds. After some discussion a committee was appointed to confer with the directors and examine the company's condition, and was instructed to report to an adjourned meeting to be held Dec. 20. The interest will have been in default six months on Jan. 3, and after that time the State Treasurer is authorized by law to take possession of the road for account of the bondholders, if the funding proposition is not accepted.

Chicago & Illinois Southern.

In the foreclosure suit of the Farmers' Loan & Trust Company, trustee, against this company (formerly the Decatur, Sullivan & Mattoon), argument on the final decree was heard in the United States Circuit Court in Chicago Dec. 4.

Kansas Pacific.

A considerable number of the bondholders met in New York, Dec. 6, on a call issued by Mr. Henry Villard, one of the receivers and Agent for the Frankfort bondholders' committee. Mr. Villard made a statement setting forth the circumstances of the first default and the subsequent agreement with the bondholders by which half the interest was to be paid and the rest funded. Under that agreement, he said \$3,200,000 had in two years been devoted to payment of the floating debt, but on

Nov. 1 default was made in the payment of the half-coupon then due. The floating debt is stated now at \$1,250,000, of which \$300,000 are unsecured debts, the rest overdue pay-rolls, notes payable, supply bills and similar accounts. It was resolved that the Chairman of the meeting, Mr. H. C. Vail, appoint a committee of nine to represent all the various interests in the road, and that the committee be instructed to communicate with the Frankfort committee of bondholders and to operate with them.

During the meeting Mr. Villard stated that in case of a foreclosure and sale of the road, two parties were ready to buy it; but he was not at liberty to tell what price they would be willing to pay for the property.

It is said that a number of bondholders intend to petition the Court to appoint Mr. H. R. Baltzer, of New York, one of the receivers, to represent their interest in the property.

Monomonee River.

A contract for the construction of this road has been let to D. L. Wells & Co., of Milwaukee, Wis. The section to be built is from the Chicago & Northwestern at Spaulding, Mich., 22 miles southwest of Escanaba, westward past the Breen, Bristling and Quineeso iron mines to the Monomonee River, about 20 miles. The contract is to grade the road, build all culverts and bridges and furnish the ties.

Chicago & Pacific.

The United States Circuit Court at Chicago has made an order authorizing this company to continue to use the grade crossing of the Chicago & Northwestern track near Elgin, Ill., until March 1, 1877. The Chicago & Northwestern trains are to have the prior right to the crossing, and the Chicago & Pacific is to pay the signalmen and to keep the crossing in order.

Chicago & Northwestern.

At a meeting of the board held in New York, Dec. 7, the following statement was presented for the six months ending Nov. 30:

	1876.	1875.	Inc. or Dec.	P.c.
Gross earnings.	\$7,049,896 58	\$7,926,274 12	Dec. \$276,877 64	3.5
Working exp's.	4,184,263 48	4,591,394 67	Dec. 407,131 19	8.9
Net earn'g's	\$3,865,633 10	\$3,334,879 45	Inc. \$130,753 65	3.9
Int'st on bonds, including gold premium	1,728,629 86	1,754,231 73	Dec. 25,402 87	1.4
Taxes	85,102 38	100,333 46	Dec. 15,231 08	15.2
Rental of Iowa roads	620,349 75	631,962 23	Dec. 11,012 48	1.7
Sinking funds	40,120 00	40,120 00	Dec. 0	0
Miscellaneous u.s. old taxes, etc.	15,017 07	Inc. 15,017 07
Total charges	\$2,489,418 56	\$2,526,047 42	Dec. \$36,628 86	1.5
Surplus	\$976,214 54	\$808,832 05	Inc. \$167,382 51	20.7

On this showing it was resolved to pay a dividend of 2 1/2 per cent. on the preferred stock. This will absorb about \$537,500 of the surplus, leaving about \$488,700 to be carried forward. It is stated that the floating debt has been entirely settled.

The working expenses were 54.70 per cent. of earnings in 1876, and 59.13 per cent. in 1875.

Toledo, Peoria & Warsaw.

The Receiver's report for October and November is as follows:

Balance on hand Oct. 1.....	\$15,443 08
October receipts.....	179,222 41
November receipts.....	144,028 04
Total.....	\$358,693 53
October disbursements.....	\$159,932 66
November disbursements.....	157,825 14
Balance, Dec. 1.....	\$20,985 73

In October the receipts exceeded the disbursements by \$19,289.75; in November the disbursements were in excess by \$13,797.10, making an excess of receipts of \$5,492.65 for the two months.

Illinois Central.

The Land Department reports for November sales of 308.44 acres for \$1,850.64. The cash collected on land contracts was \$16,887.52.

The Traffic Department reports earnings in November as follows:

	1876.	1875.	Decrease.	P. c.
In Illinois, 707 miles.....	\$440,937 86	\$574,119 27	\$133,781 41	23.8
In Iowa, 492 miles.....	139,738 27	195,972 87	\$56,234 60	29.5
Total, 1,100 miles.....	\$580,106 13	\$773,092 14	\$192,986 01	25.0

The Illinois earnings were \$623 per mile; the Iowa earnings \$548 per mile, the average for the whole line being \$523 per mile.

Jacksonville, Pensacola & Mobile.

The Governor of Florida gives notice that, in pursuance of the act of June 24, 1869, known as an "Act to Perfect the Public Works of the State," and whereas this company has defaulted on the interest due on its bonds for more than twelve months, he will cause it to be sold at public sale in Tallahassee, Fla., March 5, 1877, at noon. The sale will be made "subject to the vendor's lien held by the Board of Trustees of the Internal Improvement Fund of the State of Florida, for the unpaid purchase money due for said road."

Kansas City, Memphis & Mobile.

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Kansas Central.

Local papers report that a contract has been let for an extension of this road for 25 miles west from the present terminus at Holton, Kan., and that another contract is to be let soon.

Jonesboro.

Work has been begun on the grading of this road, which is to extend from the St. Louis, Iron Mountain & Southern at Minton, Ark., westward 25 miles to Jonesboro.

Missouri, Kansas & Texas.

The Sherman (Texas) *Register* says: "Major Shallenberger, assistant engineer of the Missouri, Kansas & Texas Railroad, has received instructions to survey a route from Denison to Sherman for that road. The route chosen will probably be on the east side of the Central, and arrangements will be made to run into the union depot. At the same time comes the equally reliable intelligence that under instructions from headquarters work has ceased on the Red River and Rio Grande. It is very evident that some compromise has been effected between the Missouri, Kansas & Texas and the Texas & Pacific railroads, by which the Missouri, Kansas & Texas comes to Sherman, and probably goes from this point to Fort Worth, over the Texas & Pacific track. The Texas & Pacific are required to build the road to Fort Worth within a few months,

and the Missouri, Kansas & Texas has been making every effort to get west. Both roads are somewhat crippled, and each has feared that the other would get west first."

Illinois Tax Cases.

Advices from Springfield, Ill., dated Dec. 5, say: "In the United States Court to-day, on a motion made by Attorney-General Edsall, as reported yesterday, an order was issued upon the Receiver of the St. Louis & Southeastern Railroad directing him to pay the State and local taxes due on that road up to 1875 before the first Monday in January."

"The Receiver of the Springfield & Northwestern Railroad was the recipient of a similar order, except that in this case the time was extended until March 1. In both cases authority was given to the county collector to seize the property of the roads if the payment is not made."

Grand Junction.

The town of Belleville, Ont., has voted a bonus of \$50,000 to this road, conditional upon the completion of the line to Peterborough.

California Pacific.

It is said that work will be begun very soon on the extension of the Vacav Valley Branch from its present terminus at Winter, Cal., northward to Cache Creek 18 miles. A new town called Madison has already been started at the proposed terminus. The extension will furnish an outlet to a considerable extent of wheat country.

Dallas & Wichita.

Work has once more been resumed on this road, and it is stated that the new contractor, Mr. Henderson, has made arrangements to dispose of a large amount of the bonds of the road.

Boston, Hoosac Tunnel & Western.

A company by this name has given notice of a petition to the Massachusetts Legislature for authority to lease and operate railroads in Massachusetts, to contract for the use of the Hoosac Tunnel and State road, and for such further legislation as may be necessary to enable it to organize, complete and work an independent line from Boston to some point on Lake Ontario, by way of the Hoosac Tunnel.

Western & Atlantic.

In the Fulton County Superior Court at Atlanta, Ga., last week, in the case of Seago and others against this company a demurrer filed by the company was sustained and the bill and complaint dismissed. This was the suit begun to set aside the lease of the road to the present company by the State of Georgia on the ground of fraud in the making of the contract.

Consolidation, Mogul and American Locomotives in Freight Service.

At the last convention of the Master Mechanics' Association during the discussion of the report on "Locomotive Construction," reference was made to some experiments made by Mr. Isaac Dripps on the Philadelphia & Erie Railroad, and the Secretary was requested to secure additional information concerning them from Mr. Dripps, and publish it in the report of the convention. This has been done, and below we copy Mr. Dripps' letter:

PHILADELPHIA, Pa., Aug. 31, 1876.

ASSOCIATION:

DEAR Sir: Agreeably to your request I herewith send you a history of the experiments made at Renovo, Pa., on the Philadelphia & Erie Railroad with three different classes of locomotives—eight-wheel, ten-wheel and consolidation class—to ascertain the amount of frictional resistance of each class of locomotive in passing over a curved track.

The dynamometer used in making these experiments was an instrument designed and put in use by myself. The instrument is fastened permanently to the floor of the car, and is arranged with rollers, through which a roll of paper traverses.

A pencil bar is connected with the draw-bar of the car, which records upon the moving paper the amount of force exerted. The paper receives its motion direct from the car axle. The instrument is self-registering, both when going ahead and when backing.

These experiments were made with locomotives belonging to the Philadelphia & Erie Railroad Company, upon the Shippensburg curve, near Renovo. The curve is one of 4% radius, 1,432 feet.

The locomotives were in good working order, and were generally taken for the experiments as soon as detached from their trains, the only preparation necessary being to disconnect the piston rods from the cross-heads, so as not to have the friction of the pistons in the cylinders; all other connections were left precisely as if running by steam, so that the friction due to all the working parts of the locomotives, except the pistons within the cylinders, would be indicated.

The locomotives experimented with were pulled by another locomotive. I am aware, however, that the proper plan would have been to have pushed the locomotive experimented with ahead of the dynamometer car and working locomotive; but, owing to the presence of considerable snow on the ground, the wind occasionally blew snow on the rails, which was more convenient to remove by placing a locomotive ahead to pull the locomotive experimented with. For this reason the locomotives were pulled during the trials instead of pushed.

During all these experiments the speed was kept as near ten miles per hour as possible.

I was personally assisted by W. A. Dripps and W. L. Foster, master mechanics of the Philadelphia & Erie Railroad, and I know that the experiments are correct and can be relied on.

Accompanying this I send you a tracing, showing a diagram of the three different classes of locomotives experimented with, giving the length of wheel-base, total weight, the distances and weights of the bearing points on the rails, and the friction in pounds, as taken from the dynamometer diagrams of each class of locomotives, which data give a true comparison of the friction on curves as generated by the different classes of locomotives.

These experiments prove, conclusively, that heavy locomotives, properly designed, with a short wheel-base, and with as many bearing points on rails, within such base, as practicable—thus reducing the weight on each bearing point—will pass around curves with less friction, and be less destructive to the track, than the ordinary passenger locomotives of much less weight. Of course, these heavy locomotives are best adapted for slow speeds, and will show the greatest economy, and will work to the best advantage, on railroads having a double track, heavy grades, and a heavy freight traffic.

The effective power of the "consolidation class" of locomotive is 50 per cent. more than the ordinary six-wheel connected freight locomotive; and, from actual service, I find that locomotives of this class work up to their power fully as well; in fact, better than the six-wheel connected locomotive. Two locomotives of the "consolidation class" will do the same work—haul as many cars—as three of the six-wheel connected locomotives; and, as three of the six-wheel connected locomotives, when new, will cost \$10,000 more than two of the "consolidation class," there is thus a saving of \$10,000 in the original outlay, and the saving of wages of the crew of one locomotive daily; and, with a properly constructed locomotive of the "consolidation class," the running repairs for tonnage

hauled will be less than any other class of locomotives now in use.

I am, yours very truly, ISAAC DRIPPS.

TRIALS OF "AMERICAN" AND "MOGUL" LOCOMOTIVES ON THE BOSTON & ALBANY RAILROAD.

The following is part of an appendix to the last report of the Master Mechanics' Association:

It will be remembered that at the ninth annual meeting a lengthy discussion was had upon the relative merits of the ordinary eight-wheel and the heavier classes known as the Mogul and Consolidation engines for freight service.

The point made by those favoring the Consolidation engine was that, on account of the great adhesive power and boiler

The following is the experiment alluded to:

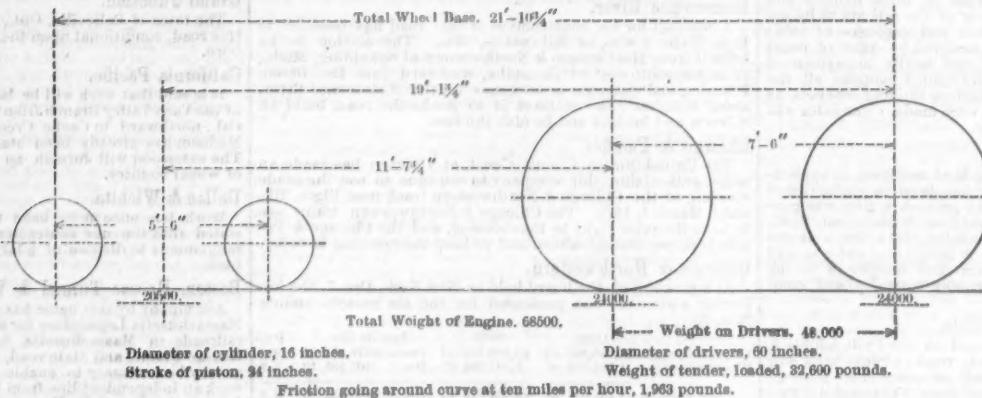
"The recent trials of locomotive engines upon the Boston & Albany Railroad have excited considerable attention among railroad men, and questions have been put by them as to the peculiarities and conditions of the competing engines; and we here give, as near as we can, the relative forms and proportions of the parts that are thought to bear upon the general result. One of them, the 'Brown,' is an ordinary Mogul engine, having three pairs of driving wheels and a single pair of guiding wheels, was built by the Rhode Island Locomotive Works, from specifications furnished by the Boston & Albany Railroad Company, and is about three years old.

"The other two engines, the 'Virginia' and 'Adirondack,'

of which were empty) were taken west by each engine. The fuel consumed by the 'Brown' was 80,850 pounds of coal, costing \$107.97; by the 'Virginia,' 23,924 pounds, costing \$83.73.

"On the second trial, between the 'Brown' and the 'Adirondack,' nine round trips were made between Springfield and Boston, 224 cars, less 24 from Worcester to Boston, were taken east, and 320, less 5, from Worcester to Springfield, west by the 'Brown'; and 228 east, and 307, less 3, from Worcester to Springfield, west by the 'Adirondack.' The fuel consumed by the 'Brown' was 106,158 pounds, costing \$87.1; by the 'Adirondack,' 83,090 pounds, costing \$290. The average time upon this trial was (going east) to Charlton Summit, 1 hour and 4 minutes each trip in favor of the 'Adirondack,' and from Bos-

PASSENGER ENGINE NO. 1034, PHILADELPHIA & ERIE RAILROAD.



capacity, much larger trains could be hauled, and thereby a large saving in train hands and in the number of locomotives required to do the work would be effected; and, on the other hand, it was as strongly urged that the increased friction, on account of the extended rigid wheel-base, the wear and tear to cars consequent to drawing these long trains, together with the destruction to the track, more than equaled any saving in this direction.

The advocates of the Consolidation engine deny the existence of any extra friction, and it being known that some extensive experiments had been made by Mr. Dripps, of the Pennsylvania Railroad, to determine this question, the Secretary was instructed to write this gentleman and obtain from him the result of the tests made. These were kindly furnished,

were of the ordinary eight-wheel kind, having two pairs of driving wheels, and a four-wheel truck, were built at the shop of the Boston & Albany Railroad Company, at Springfield, by Mr. Wilson Eddy, Master Mechanic, and have peculiarities long since adopted and adhered to by him. The 'Virginia' was new, and the 'Adirondack' about three years old. All the engines were put in complete order by parties most interested in them, and also run by men most disposed to do them justice.

"The cylinders of all were the same size, 18x26; the driving wheels were also the same diameter, 4 feet 6 inches, except those of the 'Virginia,' which were 5 feet.

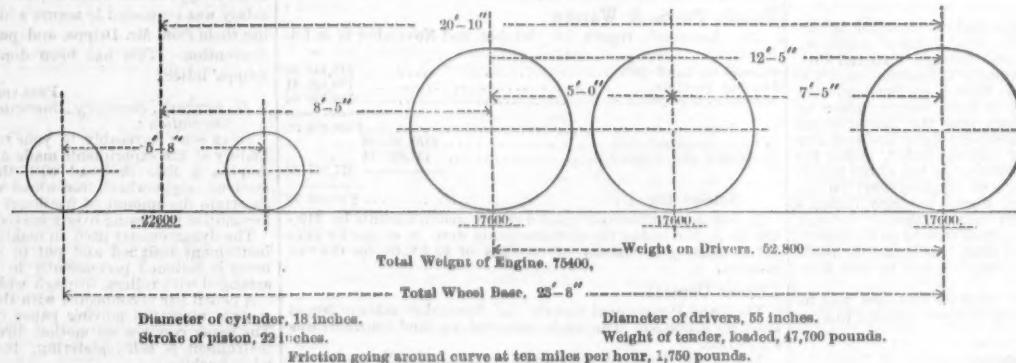
"The boilers differing in these particulars: The furnace of the 'Brown' was 65 1/2 inches long, 36 inches wide, and 56 1/2

ton to same summit, 1 hour and 30 minutes in favor of same engine. On the third trial between the same engines, 14 round trips were made between Greenbush and Pittsfield; 317 full loaded cars were taken east and 327 west by the 'Brown'; 317 cars east and 372 west by the 'Adirondack.' The fuel consumed was 86,148 pounds coal by the 'Brown,' costing \$80.54; and 69,676 pounds, costing \$226.36, by the 'Adirondack.'

"Thus it will be seen that in the 37 days' trial the Mogul burnt 235,148 pounds of coal, costing \$790.54; Springfield engines, 176,690 pounds, costing \$600.11. In favor of the latter 48,458 pounds, and \$190.42.

"Now, the question naturally arises, what has caused the difference in consumption of fuel and consequent expense? No doubt, in this particular, engineers will differ, but here it is

Freight Engine No. 1119, Philadelphia & Erie Railroad.



and will be found duly recorded in another part of this report. About the same time the Secretary also received a detailed statement of a series of experiments made on the Boston & Albany road, extending over a period of 37 days, to test the capacity and economy of two of their own ordinary eight-wheel engines with a Mogul engine, built by the Rhode Island Locomotive Works, with result decidedly favorable to the company's build of engines. The point at issue being between heavy and light engines, and the difference between the two classes of engines being given, and also the points peculiar to the Boston & Albany build of eight-wheel engines, the Secretary has taken the liberty to include this test in an appendix to this report, thinking it would at least interest the members and might lead to the development of some ideas in locomotive

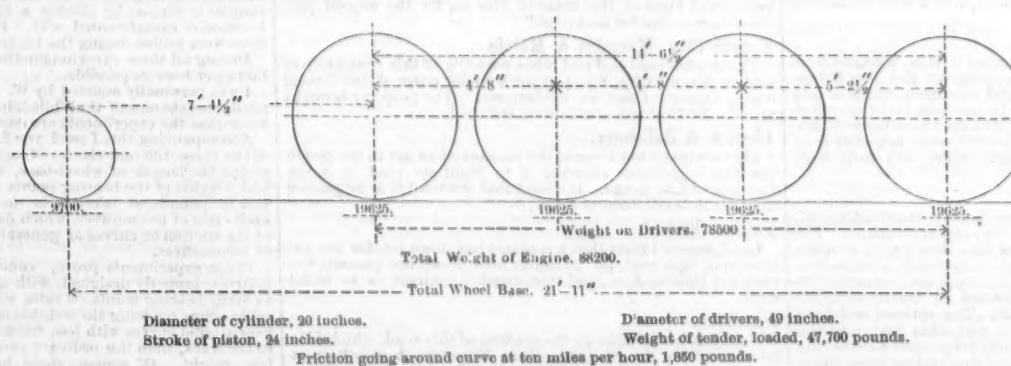
inches deep; tubes, 162, 2 inches diameter, 11 feet and 4 inches long. Those of the 'Adirondack' and 'Virginia' 54 inches long, 41 1/2 inches wide, and 51 1/2 inches deep; tubes, 162, 2 inches diameter, and 11 feet and 10 inches long. So it will be seen that as to area of grate there were 60 square inches difference in favor of the 'Brown,' and 42 square feet in favor of the 'Virginia' and 'Adirondack.' The weight of the 'Brown' is 73,600 pounds, 55,200 pounds upon the driving wheels. The 'Virginia' and 'Adirondack' 67,150 pounds, and 43,000 pounds upon the drivers.

"The marked differences are in these particulars: The 'Brown' has the ordinary form boiler, with steam dome and dry pipe. The 'Adirondack' and 'Virginia' have straight-top boilers, without dome, with perforated steam pipe, throttle

not considered to arise from any particular feature alone, but from a combination of them, co-operating to the same end.

"First, the Springfield boiler is known to be a free and liberal steamer with ample steam room. The furnace is wider and shorter, which brings all parts of it within reach of the fireman, so that he can put the coal where he wants to without throwing it. Then the perforated steam pipe, which takes steam from and directly over the point where it is made, is supposed to have considerable effect upon the dryness of the steam used. The throttle in the smoke box, as close as possible to the cylinders, allowing the steam to accumulate in the pipes and chest to a higher pressure, during the interval when both valves are closed, is believed to act favorably upon the economical expansion of the steam.

Freight Engine No. 1710, Philadelphia & Erie Railroad.



construction that, although long held by some good master mechanics, have not been generally thought to be correct, but which in this case must have had an important bearing or else the claim of superiority of the Mogul or Consolidation engine over ORDINARY eight-wheel engines is not well founded. It affords a striking illustration of the wide discrepancy existing between theory and practice, to see one of the oldest and best constructed lines of the country adopting the largest class of engines known, drawing trains of a hundred cars, which must require heavier rails and heavier cars, as the best and most economical power for conducting a heavy traffic; and, on the other hand, speculation running wild over imaginary dividends from narrow gauges, run with engines so light that to do the work of a first-class road engines and trains instead of cars in a train must be numbered by the hundred.

valve in smoke box. The distinctive differences between these engines is thought to be in the steam ports, those of the 'Brown' being 14 inches long and 1 1/2 inches wide; those of the others 10 inches long and 1 1/2 inches wide.

"At the first trial on the Western Division, between the 'Brown' and 'Virginia,' the 'Brown' had valves with 1/2 inch outside lap, no inside lap. On the second trial on the Eastern Division, and also the third on the Western Division, the valves of the 'Brown' were changed to 3/4 inches outside and 5-16 inch inside lap. The valves of the others have all along had 1/2 inch lap outside, and cut out 1-16 inch lead on each end inside. The throw of valves was in both cases 5 inches.

"On the first trial between the 'Brown' and 'Virginia,' five round trips were made between Greenbush and Pittsfield, 105 full loaded line cars were taken east, and 175 (a large number

"The smaller valves and ports are believed to be of great importance (not that they should be unduly contracted); but only this. They should be just large enough, for it is considered that a valve unnecessarily large will make an unnecessary friction, and will waste the difference of contents of the port at every exhaust, and will act severely upon the fire.

"On the other hand, the competing engine was a Mogul, with an additional pair of driving wheels and weight, with a proportional addition of friction of parts. The eccentric rods were short, and gave a large addition of lead when linked up. In other respects it is so much like the ordinary standard of engines of its class, that we need not give the particulars. We here leave the engineering world to speculate upon it as they will. And no doubt much good will come out of these elaborate and exhaustive trials."